

POPULAR MECHANICS

BECAUSE
THERE'S
SO MUCH
YOU WANT
TO DO
THIS YEAR



PLUS

THESE TREASURE
HUNTERS FOUND
JESSE JAMES'S
GOLD [P.32](#)

A REALLY FAST
WAY TO CLEAN
YOUR CAR [P.20](#)

THE VISIONARY
MORTICIAN
WHO BEATS BACK
DEATH [P.44](#)

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// STANDARDS //

1 POP QUIZ → Commerce editor Kevin Cortez shares his top travel tip, his favorite hiking boots, and the ultra-durable watch he can't live without. p.2 / Digital designer Hunter Young on the humidifier that helps her sleep and her go-to foraging app. p.4

2 INSIDE → *Go behind the scenes with Pop Mech editors and contributors.* Pull back the curtain on our cover shoot. p.6 / Meet the future of deathcare. p.8 / The smartest way to operate a track saw. p.10 / Unraveling the myth of America's most infamous outlaw. p.12 / A hard hat may be your most important accessory. p.14 / How to make use of old scrap wood. p.16

3 Can't Stop Thinking About... Tour the inside of an M1 Abrams tank. p.19 / Keep your ride squeaky clean with a waterless car wash. p.20 / The per-hour cost of flying America's war machines. p.22 / Explore a newfound cosmic structure lurking across the Milky Way. p.24 / Why we're ditching the pesky leap second. p.26 / A 10-second test that can shed light on your overall health. p.28 / We may be on the brink of a nuclear fusion breakthrough. p.30

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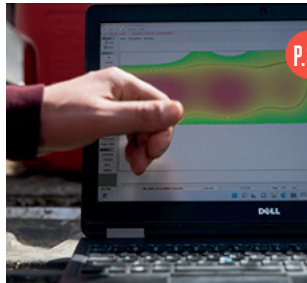
5 Made Right → Our test editor's Felco 2 Pruners have delivered sharp, clean cuts for almost two decades. p.72

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8 More → Remove a tricky stripped screw; sneak a peek at our latest digital issue; the affordable impact driver our field testers loved. p.80

// FEATURES //



Treasure Hunters May Have Found Jesse James's Lost Gold

The legendary treasure could be worth tens of millions—if the team can dig it out of the ground.

By David Howard



After You Die, Monica Torres Can Bring Life Back to Your Body

The groundbreaking mortician is pioneering new techniques to restore the dead and provide closure to grieving families.

By Eleanor Cummins



Pop Project

With a few simple tools, you can turn scrap wood into a sturdy Shaker-style step stool.

By Joe Truini



Popular Mechanics Tool Awards 2023

The best of the best power tools, hand tools, and accessories we tested this past year.

By Roy Berendsohn

// ON THE COVER // TOOL AWARDS 2023 / PHOTOGRAPH BY TREVOR RAAB



KEVIN CORTEZ

Commerce Editor

Obsessed with mean-looking hiking shoes and sweet-looking granola.

I'M AN EXPERT IN...

Clothes. I've spent a lifetime wearing them, but in the last decade, I've started to note the different textures, fabrics, and functional aspects of specific pieces. I've also devoured countless podcasts on the subject to try and learn as much as I can about the process of producing and manufacturing clothing.



ONE PIECE OF GEAR I CAN'T LIVE WITHOUT

My **Casio G-Shock GW-M5610-1**.

I love G-Shocks because they're tough as nails, and my basic square-faced model has stood the test of time. I've had one

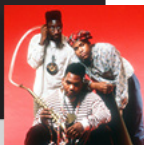
for about five years now—I've dinged it up, stepped on it, and smacked it against things, and it still looks as good as it did on day one. It's also solar-powered, so I'll never have to replace it with another quartz battery. Keep your smartwatch—I love my digital one.

My Passion Project

I write a newsletter called *You Better Not Be Online* so that I can send my feelings and thoughts to the people on the Internet with whom I have parasocial relationships.

3 Parting Shots

- 1/ Pile is the greatest band in the universe.
- 2/ The best hip-hop album of all time is *Buhloone Mindstate* by **De La Soul**.
- 3/ You should really be eating more vegetables.



MY #1 TRAVEL HACK

If you're heading back from vacation, lighten the haul by mailing your dirty clothes home. It'll prevent your suitcase from smelling dank and give you more space for packing souvenirs.



What's On My Feet?

I'm currently rotating between two hiking boots from Hoka: the Tor Ultra Lo in olive and the Kaha 2 GTX in blue coral (shown). The former shoe invaded my Instagram feeds by way of Korean fashion pun-dits and various hiking accounts I follow, and I was able to nab it before the streetwear crowd inevitably made it a hot item. I love how aggressive both shoes look: ready to step on (and maybe break) literally anything.

What's on My Desk?

An adorable little Japanese deity statue. It has fake mossy grass on it that I like touching in between typing out thoughts.

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132 South 3rd Street
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MARCH/APRIL 2023

PRINTED IN THE U.S.A.





Smooth Sailing Along **THE MISSISSIPPI**

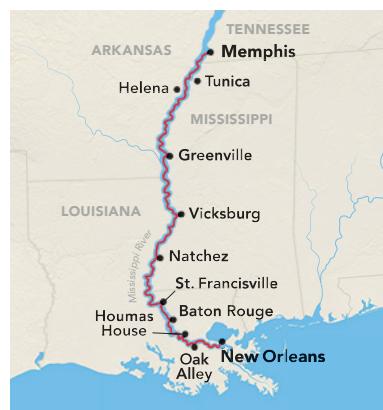
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HUNTER YOUNG

Digital Designer

Weird, wild, and kind of nerdy. You could say I fit in well here.

The Conspiracy Theory That May Be True

I'm a big believer in simulation theory. The thought that we're all in some juvenile alien's computer makes me feel better about the current state of everything.

THE BEST THING I EVER BOUGHT

A plane ticket to Savannah, Georgia. I had been wanting to travel forever, but with saving for college and actually being in college, it was hard for me to plan big things. My sister and I went to Savannah in 2021, and it really sparked my need to "see it all." In 2023, I already have plans to travel to another country for the first time and to visit Colorado to camp around! Traveling is a big source of happiness for me, and I'm forever thankful for that first plane ticket that started it all.



I Can't Sleep Without...

My Canopy humidifier. Recently, I've been running it with a few drops of lavender essential oil, and it makes every night extra dreamy.



I Wish the World Knew More About...

The importance of our relationship with nature. Humans are a part of nature, but I think we forget that a lot of the time.

My Simple Plan to Change the World

If everyone took some time to step barefoot into some plushy grass, and maybe smell a flower or two, I think everyone would start being a little nicer to each other.

Favorite Mind-Blowing Fact

Mantis shrimps are able to see 12 channels of color, while humans can see only three (red, green, and blue). I bet you can't even imagine what a new color would look like.

Mom Knows Best

My mom freezes soup leftovers in cups, which she then pops out and puts into a bag for me to take home. It's great because I just take a "cup" or two and throw them into a pot to reheat when I want them. No soup goes to waste, and it's a great, quick meal.

MY FAVORITE APP

When my sister and I got into foraging last spring, we used Plantsnap to help identify what each plant might be. We then used that knowledge to further search and properly identify most of the plants we found.



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MAXJAX

I Inside

2

// GO BEHIND THE SCENES WITH POP MECH EDITORS AND CONTRIBUTORS //



STAFF PHOTOGRAPHER TREVOR RAAB

sits in our photo studio contemplating a myriad of directions to go with our Tool Awards cover shoot. Many of us home-improvers, DIYers, and builders can relate—usually working independently, figuring things out one step at a time.

INTRODUCING POP MECH PRO

Pop Mech Pro is the only way to read all of the exclusive, in-depth reporting from *Popular Mechanics*.

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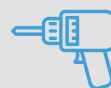
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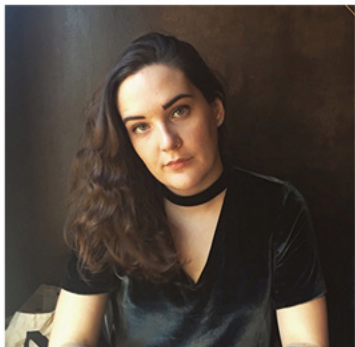
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The Changing Face of Deathcare

MONICA TORRES FIRST came across my radar when I was reporting on the 2021 National Funeral Director Association's annual convention. Torres was there presenting continuing education classes on the art and science of embalming—skills she estimates she's used on more than 1,500 bodies in the pandemic alone. As you'll see on p.44, there's a lot about Torres that stands out in a crowd, including her signature style, commitment to technical innovation, and social media savvy. When *Popular Mechanics* asked me to write a story about deathcare, I knew exactly who to call. In August, I flew to Phoenix, and spent the next few days trailing Monica as she met with old clients, explained her techniques, and plotted her next career move. The experience taught me that deathcare is interdisciplinary, drawing from science and art, and requires a deep well of empathy.



WRITER: ELEANOR CUMMINS

STORY: AFTER YOU DIE, MONICA TORRES CAN BRING LIFE BACK TO YOUR BODY



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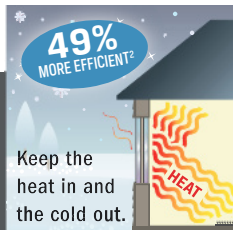
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[†]Using U.S. and imported parts.



Our Best Track Saw Tip

WE'VE SPENT A LOT OF time testing track saws over the past few months, finding the best one for this year's Tool Awards.

One key thing we've learned in using them for various projects is that the track should always be placed on the "keep" side of the cut. That is, you place the track on the piece that you want to keep, not on the side that becomes waste (sometimes also the side that becomes the next cut piece). This way, the kerf left by the saw does not reduce the width of the piece you are

trying to make (the "kerf" is material removed by the saw blade). If you inadvertently put the track on the wrong side of the cut line, your finished workpiece will be too narrow by the thickness of the blade.

Also, in instances where the track is not long enough to complete the cut, you have several options at your disposal:

A → Simply stop the saw and slide the track forward.

B → Buy an accessory piece of track that attaches to the existing track, extending its length.

C → Clamp a straightedge on the side of the track to ensure that when you

slide the track forward, you will slide it in a straight line, matching the existing cut.



WRITER: ROY BERENDSOHN

STORY: POPULAR MECHANICS TOOL AWARDS 2023

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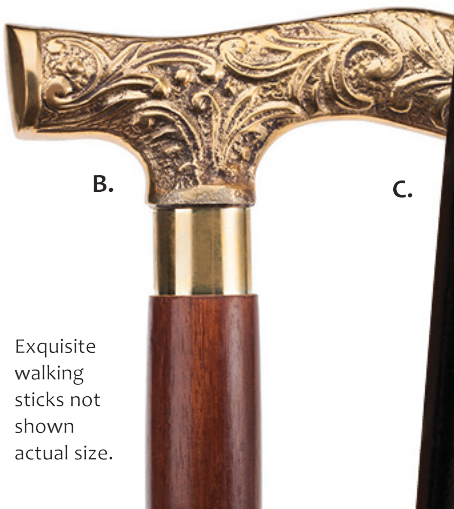
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A.



B.



C.



D.

Exquisite walking sticks not shown actual size.

Busting the Myth of Jesse James

N “TREASURE HUNTERS MAY HAVE Found Jesse James’s Lost Gold” (p. 32), David Howard recounts the symbols, technology, and history that led two men to believe they’ve located a treasure vault buried by the infamous outlaw. But James was no American Robin Hood, as T.J. Stiles, author of *Jesse James: Last Rebel of the Civil War*, explained to Howard.

HOWARD: HOW DID JESSE JAMES BECOME A FOLK HERO? / Stiles: For the first 10 years after the Civil War, James promoted himself as a victim of radical Republican vindictiveness and as a Confederate avenger. That resonated in his bitterly divided home state of Missouri, even though he committed most of his crimes simply for the money. His insistence on a political identity set him apart from other post-Civil War outlaws, and it likewise helped former Confederates rise to power in the 1870s.

WHEN DID THAT IDENTITY BECOME A ROBIN HOOD PERSONA? / It changed after the disastrous 1876 Northfield, Minnesota, bank robbery. He disappeared from public view for three years. When he reemerged, Reconstruction was over and there was no longer a political context to win him support. His death at the hands of a traitor, and the rise of Populism and anti-corporate sentiment, helped to create a false mythology of him as an American Robin Hood.

WHO WAS THE REAL JESSE JAMES? / Jesse James should not be celebrated. He went to war to force his neighbors into a republic committed to slavery. He committed atrocities in the Civil War, and then led a life of violence with the hope of ending Reconstruction and putting former Confederates back into political power.

He was too much of a criminal—in it for the money—for us to say simply he was engaged in terrorism, but we have to keep that category in mind when we describe his banditry.



WRITER: DAVID HOWARD

STORY: TREASURE HUNTERS
MAY HAVE FOUND JESSE JAMES'S
LOST GOLD

SECRETS OF A BILLIONAIRE REVEALED

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Why You Need a Hard Hat

DON'T ROUTINELY WEAR A hard hat. It's unnecessary for most of my work. (However, I wear a forestry helmet with face protection when felling trees.) But let this be a lesson to you:

On a volunteer construction project a few years ago, a beam came loose, and although another volunteer caught it, the falling lumber gave me a powerful konk on the head.

While you may think a hard hat is only for pros, keep in mind you're probably more likely to find yourself in harm's way out of inexperience. So, buy a hard hat and wear it when there's a risk of falling objects or other hazards (such as nails poking through roof sheathing). If you're in the market for one, we liked the WaveCel T2+ Pro for our Tool Awards (p. 58). You may feel silly and get some ribbing for wearing it, but it's better than a concussion or something much worse.—*R.B.*





BACK-BREAKING WORK REQUIRES SOME HELP

Everyone feels the hurt as you age, but CBD can help you deal with it

Life really does fly by. Before I knew it, my 60s had arrived, and with them came some new gifts from dear ol' Mother Nature—frequent knee pain, stress, low energy and sleeplessness. Now, I'm a realist about these things, I knew I wasn't going to be young and springy forever. But still, with "golden years" nearly on my doorstep, I couldn't help but feel a little cheated. That is until I found my own secret weapon. Another gift from Mother Nature.

It began a few months back when I was complaining about my aches and pains to my marathon-running granddaughter, Jen. She casually mentioned how she uses CBD rub to help with her joint pain. She said that CBD gave her more focus and clarity throughout the day and that her lingering muscle and joint discomfort no longer bothered her. She even felt comfortable signing up for back-to-back marathons two weekends in a row this year. That made even this self-proclaimed skeptic take notice.

But I still had some concerns. According to one study in the Journal of the American Medical Association, 70% of CBD products didn't contain the amount of CBD stated on their labels. And, as a consumer, that's terrifying!

If I was going to try CBD, I needed to trust the source through and through. My two-fold research process naturally led me to Zebra CBD.

First, I started calling my family and friends. Call me old fashioned but I wanted to know if there were people whom I trusted (more than anonymous testimonials) who've had success using CBD besides my granddaughter.

Secondly, I wanted cold hard facts. Diving deep into the world of CBD research and clinical studies, I came across Emily Gray M.D., a physician at the University of California at San Diego (UCSD) Medical School and medical advisor to Zebra CBD who is researching the effects of CBD. Dr. Gray wrote "early results with CBD have been promising and we have a lot of research underway now. I've had several pa-

tients using CBD with good success. It's important that you know your source of CBD and how to use it properly."

After hearing it from the doctor's mouth, I returned to my research, asking more people and was amazed by the number of close friends and family who were already on the CBD train. Apparently, I was the only one without a clue! And funny enough, a couple of friends who commented were using the same brand as my granddaughter—Zebra CBD. There was no consensus as to why they were using CBD, but the top reasons given were for muscle & joint discomfort, mood support, sleep support, stress and headaches, as well as supporting overall health & wellness.

Eventually, even the most skeptical of the bunch can be won over. With a trusted CBD source in mind, I decided to give it a go.

When I viewed Zebra CBD's selection online, I was impressed by its array of products, including CBD oils called tinctures, topicals, chewable tablets, mints and gummies. After reading on their website that all their products are made with organically-grown hemp, I ordered... and it arrived within 2 days!

The first product I tried was the Rub. Now this stuff was strong. Immediately after rubbing it on my knee, the soothing effects kicked in. It had that familiar menthol cooling effect, which I personally find very relieving. And the best part is, after two weeks of using it, my knee pain no longer affected my daily mobility.

The Zebra Sleep Gummies, on the other hand, had a different but equally positive effect on my body. To take it, the instructions suggest chewing thoroughly. This was simple enough, and the taste was, well, lemony. After about 15 minutes, a sense of calm came over my body. It's hard to describe exactly; it's definitely not a "high" feeling. It's more like an overall sense of relaxation—and then I fast asleep. Needless to say, I slept great and woke up refreshed. I haven't slept like that in a long time.

While it hasn't been a catch-all fix to every one of my health issues, it has eased the level and frequency of my aches. And it sure doesn't seem like a coincidence how rejuvenated I feel.

All-in-all, CBD is one of those things that you have to try for yourself. Although I was skeptical at first, I can safely say that I'm now a Zebra CBD fan and that I highly recommend their products.

Also, I managed to speak with a Zebra CBD spokesperson willing to provide an exclusive. If you order this month, you'll receive \$10 off your first order by using promo code "**PM10**" at checkout. Plus, the company offers a 100% No-Hassle, Money-Back Guarantee. You can try it yourself and order Zebra CBD at ZebraCBD.com/PM or at 1-888-762-2699.



Save Your Scrap Wood

BUILDING SOMETHING FROM SCRAP IS A challenge because it reverses the normal order. In most cases, you build using the best part of the materials, not the discards. But I like a challenge, so I vowed to find useful stuff to make out of remnant lumber, like the Step Stool on p. 54.

Another project that we loved recently was this DIY bench. All it took were six cuts on a miter saw and a handful of screws to produce this sturdy little bench; it weighs exactly 42 pounds. Sit on it, or put some flowerpots on it. It's good either way.

To see all the steps for this bench, head to popularmechanics.com/diybench.—R.B.

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New Libido-Powering Pill Helps Men Enjoy Long-Lasting Intimacy - At Any Age

Men across America are raving about a newly enhanced potency supplement that helps achieve healthy blood flow on demand

After age 40, it's common knowledge that performance begins to decline in many men. However, a new, performance empowering pill is showing that any relatively healthy man can now enjoy long-lasting, and frequent intimacy – at any age.

This doctor-designed formula, created by leading anti-aging expert Dr. Al Sears, has already helped men overcome low and sinking libido -- and has recently undergone a potency-enhancing update – with remarkable new results.

When the first pill -- **Primal Max Black** -- was first released, it quickly became a top-selling men's performance helper, promoting intimacy across America.

It worked by supporting healthy testosterone levels. However, Dr. Sears soon realized that this isn't the only challenge men face with performance. That's when he turned his attention to blood flow.

And this became **Primal Max Red**.

PROBLEM IS, RESULTS ARE MORE MECHANICAL THAN HORMONAL

Truth is, once blood flow slows down for men, no matter how exciting it is, it won't be enough without the necessary amount...

So enjoying intimacy without healthy blood flow becomes difficult for most men.

Luckily, a Nobel prize-winning scientist discovered the simple answer to help support performance strength and confidence -- by boosting vital blood

flow -- and enhancing this essential performance function.

Using this landmark Nobel Prize as its basis, **Primal Max Red** enhanced healthy blood flow for untold millions of men around the world with the use of strong nitric oxide boosters.

While **Primal Max Black** helped maintain optimal testosterone, **Primal Max Red** tackles a lesser-known challenge.

Director, Al Sears MD, who has authored over 500 scientific papers and has appeared on more than 50 media outlets including ABC News, CNN, ESPN, Discovery, National Geographic, Lifetime, and many more say, *"Less than optimal blood flow can be part of a huge problem that affects a lot of men. And it needed to be addressed once and for all, so men would not dwell on it. Then, once we optimized it and had a great deal of success, we set out to see if we could do even better."*

The former formula had excellent results. However, new research showed that for even faster, anytime, anywhere results, increasing the dose of a key compound was needed.

So, one of the three nitric oxide boosters in the new **Primal Max Red**, L-Citrulline, was clinically boosted to 9000 mg, and the results were astounding. Which is no surprise considering that 5000 mg is considered a "normal amount" -- giving the new version nearly doubled the blood flow boosting power.

Men who had previously been unsure about their power and stamina were overjoyed to be back to their old selves and to get



A new discovery that increases nitric oxide availability was recently proven to boost blood flow 275% - resulting in improved performance.

and maintain a healthy bloodflow when they needed it.

BETTER BLOOD FLOW, STRONGER RESULTS

The best way to promote healthy blood flow throughout the body is with the use of **Primal Max Red**. By using it, when exciting signals leave the brain, blood flows much faster like it used to.

This critical action is how men across the country are enjoying full and satisfying performance at any age. No need to bother with testosterone-boosting shots, blue pills, or shady capsules that have no effect.

Primal Max Red can effectively promote healthy blood flow that most men can use for maximum intimacy. This is leading to more greater capacity and satisfaction, coupled with long-lasting performance.

"There was a time when men had little control when it came to boosting their blood flow," Dr. Sears said. "But science has come a long way in recent years. And now, with the creation of nitric oxide-boosting **Primal Max Red**, men can

perform better than ever, and enjoy intimacy at any age."

Now for men across America, it's much easier to stay at their performance peak as they get older.

HOW TO GET PRIMAL MAX RED (AND FREE PRIMAL MAX BLACK):

To secure free bottles of **Primal Max Black** and get the hot, new **Primal Max Red** formula, buyers should contact the Sears Health Hotline at **1-800-277-2921** TODAY. "It's not available in retail stores yet," says Dr. Sears. "The Hotline allows us to ship directly to the customer." Dr. Sears feels so strongly about **Primal Max**, all orders are backed by a 100% money-back guarantee. "Just send me back the bottle and any unused product within 90 days from purchase date, and I'll send you all your money back."

Call NOW at **1-800-277-2921** to secure your supply of **Primal Max Red** and free bottles of **Primal Max Black**. Use Promo Code **PMAXPOP223** when you call. Lines are frequently busy, but all calls will be answered!

Can't Stop Thinking About

3

WHAT IT'S LIKE INSIDE AN M1 ABRAMS

→ IN 1980, THE U.S. ARMY introduced its next-generation tank: the M1 Abrams. With its 105-millimeter main gun, gas turbine engine, and revolutionary armor, the Abrams had a decisive edge over the tanks of the Soviet Union. More than four decades later, it's still going strong.

That's because the M1 Abrams is a no-compromise tank, with world-class firepower, mobility, and armored protection. To get an idea of what life with an Abrams tank is like, *Popular Mechanics* spoke with U.S. Army Master Sgt. Nicholas S. Tillman, Machete Troop, 3rd

The AGT-1500 gas turbine engine inside an M1 is so hot that tankers cook food on it.

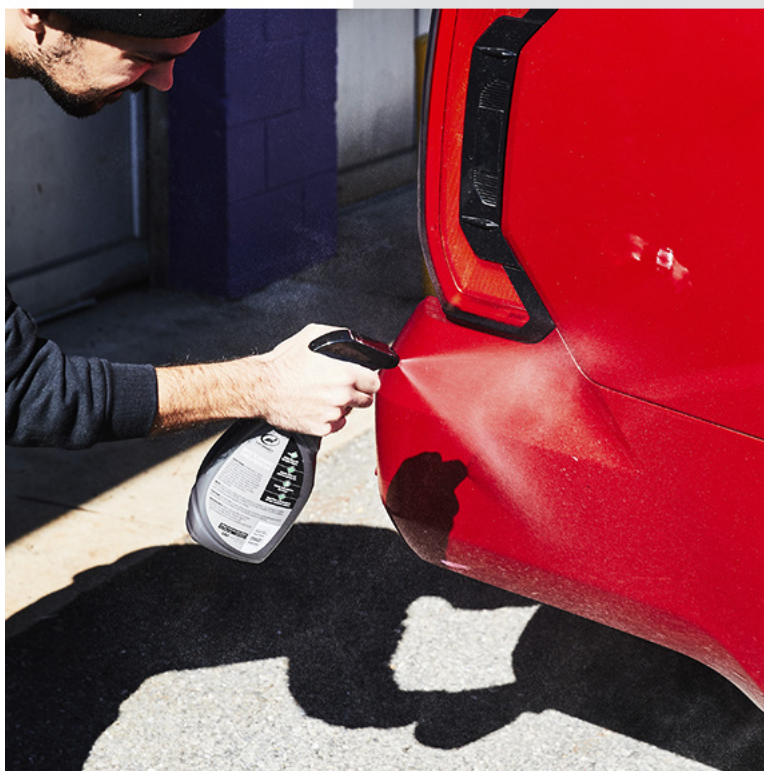
Squadron, 16th Cavalry Regiment, 316th Cavalry Brigade. He has more than a dozen years of experience and is currently an Abrams master gunner senior instructor. Here are a few of our most pressing questions on what makes the tank so badass.

How loud is it inside the tank when the gun goes off? → It's not so much that the tank itself is shuddering. The concussion caused by the main gun firing is knocking the dust and debris off the tank. Obviously, the crew and equipment are being rattled, but it isn't as bad as it seems inside. The crew members wear two sets of hearing protection as is, and with the blast envelope being outside of the tank, most of the noise is kept out of the vehicle.

In the event a 68-ton tank breaks down, what happens next? → If the tank breaks down for any reason, recovery is conducted based on the situation. We typically try to conduct "like recovery," which is where another tank in the formation moves the downed tank to a secure area for the mechanics to get it back up and running. However, there are instances where our mechanics and recovery team will come and retrieve the vehicle themselves or repair it in place. Really, it all depends on the environment and situation.

What keeps the Abrams competitive on today's battlefield? → The Abrams has remained competitive over the decades through constant upgrades. Firepower, maneuverability, survivability, and communications have all been upgraded and are far superior and much more capable than the first or even more recent models.—*Kyle Mizokami*

To learn more about the **M1 Abrams**, go to popularmechanics.com/m1abrams.



The Fast Approach to Cleaning Your Car

KEEPING YOUR CAR'S EXTERIOR SPICK-AND-SPAN not only makes your ride look good but, in some cases, can even make it more efficient. However, if you don't have water readily accessible—whether due to your region's climate or your home lacking a spigot for a hose—a proper car wash can quickly become a headache.

Thankfully, "waterless car wash" isn't an oxymoron. Though not a full replacement for a thorough washing, there are specialized sprays, waxes, and towels that make it possible to keep your rig squeaky clean.

What Is Waterless Car Wash? // As the name suggests, waterless car wash products rid your vehicle's paint of light detritus without the power of water. Unlike hoses or pressure washers, which blast away debris, waterless wash products emulsify dirt, dust, and other contaminants, suspending them within the solution—making them much easier to wipe away with a microfiber towel. These sprays are also highly lubricating to keep the dirt and other crud from scratching your paint as you wipe.



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A 12-inch stainless steel knife for only \$79



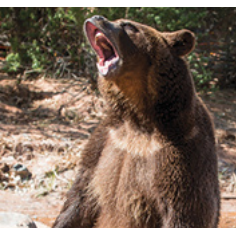
What Stauer Clients Are Saying About Our Knives



"The feel of this knife is unbelievable... this is an incredibly fine instrument." — H., Arvada, CO



"This knife is beautiful!" — J., La Crescent, MN



It was a perfect late autumn day in the Northern Rockies. Not a cloud in the sky, and just enough cool in the air to stir up nostalgic memories of my trip into the backwoods. This year, though, was different. I was going it solo. My two buddies, pleading work responsibilities, backed out at the last minute. So, armed with my trusty knife, I set out for adventure.

Well, what I found was a whole lot of trouble. As in 8 feet and 800-pounds of trouble in the form of a grizzly bear. Seems this grumpy fella was out looking for some adventure too. Mr. Grizzly saw me, stood up to his entire 8 feet of ferocity and let out a roar that made my blood turn to ice and my hair stand up. Unsnapping my leather sheath, I felt for my hefty, trusty knife and felt emboldened. I then showed the massive grizzly over 6 inches of 420 surgical grade stainless steel, raised my hands and yelled, "Whoa bear! Whoa bear!" I must have made my point, as he turned tail and headed back into the woods.

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Our Grizzly Hunting Knife features stick-tang construction, you can feel confident in the strength and durability of this knife. And the hand carved, natural bone handle ensures you won't lose your grip even in the most dire of circumstances. I also made certain to give it a great price. After all, you should be able to get your point across without getting stuck with a high price.

But we don't stop there. While supplies last, we'll include a pair of \$99 8x21 power compact binoculars **FREE** when you purchase the Grizzly Hunting Knife.

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The 3-in-1 waterless wash detailer from Turtle Wax proved the most effective throughout our testing process. Along with clearing the paint, it served as a spray wax and hydrophobic coating.

Because hydrophobic molecules repel themselves from water molecules, the coating helps water bead up and roll off the surface. This decreases the amount of dirt that sticks to your car, making it look much shinier. And, next time you give it a proper wash, it should be much easier to clean.

While the Turtle Wax is fairly pricey at around \$15 a bottle on Amazon, there are plenty of cheaper options that get the job done. We found that Adam's Polishes makes a \$10 waterless wash (without any waxing or coating abilities) that proved to be a great alternative.

The Pros // Depending on your priorities or situation, the greatest advantage of waterless car wash is just that: not having to use any water, potentially saving money and resources. But the products are also tremendously easy to use. Specifically, they're massive time-savers.

Giving my Volkswagen GTI its biweekly wash generally takes me about two hours. However, a quick spray and wipe-down took me roughly 10 minutes. I got the best results by spraying down one panel at a time, letting the product sit for about 30 seconds, and then wiping it away in straight lines. After wiping down the whole car, I checked for any spots I may have missed—these show up still looking wet—with a clean towel.

Another advantage is sheer affordability. All you need to achieve great results with waterless car wash is the product itself and a microfiber towel; we found the Adam's Polishes drying towel to work best. Meanwhile, even the most basic car wash setup requires accessories like buckets, wash mitts, brushes, and drying towels—and that's before buying more advanced items like a power washer or polishers.

The Cons // In our testing, we weren't able to remove anything more than light dust or dirt accumulated on the paint. So if you regularly go off-roading or live somewhere that sees frequent precipitation, this method may not be as useful for you. It's also not a replacement for a spring car wash to scrub away winter's accumulated snow and salt, which can damage your paint in the long run.

Also, if you're not careful, misapplying waterless car wash poses a chance of embedding dirt into your paint. Many of these types of products

(particularly cheaper versions) include fillers that increase this risk. These almost invisible layers of grime are a pain to remove, and tend to scratch your paint when wiping over them.

The Upshot // Think of waterless car wash as a great way to maintain that concourse-level shine without needing to break out the hose and a wash bucket. But if your vehicle is heavily soiled, you will unfortunately still have to fire up the heavy artillery.—*Matt Crisara*

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- A-10 Thunderbolt: \$22,531
- F-16 Fighting Falcon: \$26,927
- F/A-18E/F Super Hornet: \$30,404
- F-22 Raptor: \$85,325
- F-35 Joint Strike Fighter: \$41,986

BOMBERS

- B-52H Stratofortress: \$88,354
- B-2 Spirit: \$150,741
- B-1B Lancer: \$173,014

HELICOPTERS

- AH-64 Apache: \$5,171
- UH-60 Black Hawk: \$3,116
- MH-60R Seahawk: \$14,555
- AH-1Z Viper: \$20,642

OTHER AIRCRAFT

- E-3 Sentry: \$66,126
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2022 U.S. Government Accountability
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Scientists located
a new galaxy
cluster, obscured
by the Milky Way's
visual noise.

ers were able to find this galaxy cluster at all.

Looking Through the Galaxy → The problem with looking “through” the Milky Way galaxy to what lies beyond is that you’re dealing with an obscurity created by the Milky Way itself, called the Zone of Avoidance (ZOA). Sure, the galaxy is mostly empty space, and you could look “through” quite a bit of our local solar system in that sense, but there are two complicating factors.

The first is the physicality of the Milky Way, which is kind of like a huge over-easy egg with Earth placed in one far end of the white. This effect is called “attenuation,” wherein media like water and glass obscure the passthrough of light over a long enough distance. And then you have to add the galactic clutter of planets and stars and particulate, all of which add up to a hazy view of the clearer portions of the Milky Way. Moreover, the very center of the Milky Way is a supermassive black hole that’s millions of times the size of our sun, and millions of other stars orbit it, forming a tight, glittery cluster that’s even more difficult to see through.

The Zone of Avoidance → So, we’ve tackled what makes the shadows, but what about the light itself?

“Extragalactic background light” is the term for a special kind of light pollution that happens in outer space. Because the universe is almost infinitely enormous—and expanding all the time—the light that stars generate stays in the mix virtually forever. Think of a long-exposure photo, especially the kind that your phone might suggest taking in night mode. Light lingers and creates new illumination as it travels.

This light bounces into almost eternity, heightening the shadows created by non-luminous

What's Lurking Behind the Milky Way

SCIENTISTS SAY THEY’VE DISCOVERED a “large scale structure” in a largely unseen part of the Milky Way galaxy, according to a preprint paper published to the arXiv server late last year. (It’s been submitted to the journal *Astronomy and Astrophysics*, but it has not yet been peer-reviewed.)

To be clear, the structure here is not any kind of human-made object; rather, it’s a newfound galaxy cluster that’s been hiding out behind the Milky Way. Given how hard it is to observe other objects through the Milky Way, it’s exciting that research-

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physical barriers in the galaxy, like planets and dust. Between the luminous objects that obscure what's behind them, the supermassive black hole that obscures what's behind it, and the countless objects and speckles that obscure what's behind them, casting shadows, the scrambling effect is better than even the best patterned mask meant to fool facial-recognition algorithms.

The area this creates is the Zone of Avoidance, and it covers about 20 percent of the sky visible from Earth. It prevents us from seeing into much of the Milky Way in detail, as well as everything that lies behind and beyond it.

See You on the Dark Side of the (Galaxy) →

Scientists have had to develop entirely new ways to try to see through the physical and photonic clutter in the Zone of Avoidance. Over time, they realized that if they shifted the spectrum of light at play—from the visible spectrum to the infrared zone—the Milky Way was a lot easier to explore and survey with our broad selection of remote instruments. In the wake of that discovery, different instruments have scoped out the Milky Way using infrared bandwidths for 40 years now, starting with the IRAS survey in 1983. Scientists have also explored our galaxy using X-rays and radio waves.

Until now, though, most surveys have focused on identifying and counting galaxies or clusters in an effort to simply observe that they exist. What if this area of the sky is one superstructure that takes up the entire shadow region, like the villain in a cartoon? Yes, that sounds ridiculous, but we haven't known enough to rule it out. In this new research, scientists took it to the next level by measuring near-infrared energy in the ZOA in order to find a similarly dense region outside the Milky Way that is "hidden" within the Zone.

What they found is an extragalactic structure, which just means an object or collection of objects that exists outside the Milky Way galaxy. In analyzing the "overdense region" they chose to focus on for this study, the scientists were able to show that it has many of the same qualities as other galaxy clusters we know about. They were able to observe this and use things like redshift—tracking what is visible in the infrared spectrum and back-calculating its likely presence in the visible spectrum—in order to draw an overall impression of this dense area outside our galaxy.

—Caroline Delbert



Nixing the Chaotic Leap Second

SINCE THEIR INCEPTION OF THE LEAP SECOND 50 years ago, 27 have been added to our clocks to make sure Universal Coordinated Time aligns with our solar reality—sort of like how leap days or leap years keep our calendars from becoming a complete chronological mess.

Well, no more. Last year, government representatives at the General Conference on Weights and Measures decided to scrap the leap second, beginning in 2035 and lasting until at least 2135 (or until we discover a better method for adjusting our clocks).

What Is a Leap Second? // Human time has long been calculated by how long it takes Earth to complete a full rotation on its axis. However, there's just one problem—Earth doesn't rotate at a uniform rate. Earthquakes, volcanoes, tidal forces, and even wind patterns can affect how fast or how slow the world turns.

This is a problem because the world is built on the extreme timekeeping precision of atomic clocks, baked into the programming of orbiting satellites, financial markets, and everything in between. Atomic clocks calculate a second as "9,192,631,770 periods of the radiation

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corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom,” and cesium atoms don’t know (or care) how fast Earth spins. Over time, these discrepancies can sometimes be more than a millisecond per day. When those milliseconds add up, the world needs to add another second.

Because of tides, Earth’s rotation is slowing. This is why UTC has only needed an injection of an extra second to accomplish that small temporal course correction.

However, Earth has been recently speeding up, and on June 29, 2022, Earth completed a day some 1.59 milliseconds early, the shortest day scientists have ever recorded. If this trend continues, it could lead to the unprecedented decision to take away a second, which would potentially send the tech world into Y2K-level chaos.

A Technological Terror // Although the leap second has its defenders (mostly Russia, whose GLONASS satellites are designed with the leap second in mind), the time anomaly’s most ardent opponents include experts from the U.S. National Institute of Standards and Technology and nearly the entire technological world. In 2012, Reddit crashed due to a leap-second-related glitch in the Linux operating system and airline reservation systems went down for hours. In 2015, financial markets shut down entirely to avoid any leap-second issues, and in 2017, Cloudflare, a web-hosting network, also experienced a glitch in its software—all thanks to the dreaded leap second.

This small, extra second is so disruptive that companies like Google and Meta have instead implemented what’s called a “leap smear,” where a leap second is spread, or smeared, across a 17- to 24-hour period. However, even “smearing” isn’t a perfect solution, as those 17 to 24 hours are partic-

Globally, we rely on atomic clocks, but those don’t account for Earth’s rotation.



ularly “sensitive,” as a restart of particular servers could still cause severe outages.

The Future of Time // The leap second will be officially retired (barring any other updates or decisions) in 2035, and no new leap seconds will be added for at least another century. Luckily, estimates suggest that no serious temporal issues will arise for at least 2,000 years. By then, the world would hopefully have a few options to remediate any new issues.

One idea is for countries to simply shift their time zones by one hour at some point, effectively wiping out the astronomical misalignment in one fell swoop. A more radical idea could involve creating a single time zone for the entire world, decoupling the human perception of time with the sun’s movement, according to *Nature*.

At the moment, no one knows how scientists will align time with Earth’s rotational reality in the far future. The leap second was a valiant first attempt, but ultimately a flawed one.—Darren Orf



A 10-Second Test of Overall Health

If you can balance on one leg for at least 10 seconds, rejoice! Chances are, you will outlive many of your peers. On the other hand, if you are over the age of 50 and cannot perform this balance test, you could be at a higher risk of dying within a decade compared to your peers, according to new research published in the *British*

Journal of Sports Medicine last year.

Try the balance test yourself: Find backup balance support, like a wall or chair, in case you need it. Stand on one leg, resting your other leg on the back of the standing leg. Keep your arms at your sides. Repeat up to two more times if unsuccessful.—Stav Dimitropoulos



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Achieving Nuclear Fusion Ignition



The target chamber where 192 lasers achieved a nuclear fusion breakeven.

LAST NOVEMBER, SCIENTISTS AT LAWRENCE LIVERMORE National Laboratory's National Ignition Facility (NIF) achieved a "scientific energy breakeven" in nuclear fusion, known as "ignition." This means the reaction generated more energy than it took to power it. According to the U.S. Department of Energy, NIF scientists produced 3.15 megajoules out compared to the 2.05 MJ of energy put in; about 3 megajoules can power a one-kilowatt microwave for about an hour.

"This sets fusion energy up as a possible energy source for the future," says Mickey Wade, director of Oak Ridge National Laboratory's Fusion Energy division. Unaffiliated with NIF, Wade works closely with the International Thermonuclear Experimental Reactor (ITER), a nuclear fusion tokamak. "Now we have to figure out how to take that up to another scale in terms of large amounts of energy production."

Going Nuclear // The most familiar method of generating nuclear fusion power involves stellarators or tokamaks, donut-shaped reac-

tors that trap superheated hydrogen plasma in magnetic confinement until their nuclei fuse, flinging neutrons outward and producing energy. However, NIF's approach, called "inertial confinement," is radically different and uses lots and lots of laser beams—192 of them, to be precise.

Scientists power up and shoot these beams at a cylinder that's about the size of a pencil eraser. Inside is a pellet of deuterium and tritium that subsequently implodes. As the hydrogen with helium fuses, it produces energy. Until now, this power transfer—or the amount of energy needed to induce this fusion—exceeded the energy extracted from the experiment.

Pushing the Limits of Physics // NIF's announcement doesn't mean we'll suddenly be swimming in free energy. For one, while the experiment produced a net gain of megajoules, the relatively inefficient laser in total pulled some 400 megajoules from the grid for the shot. This means the NIF's experiment would need to be a hundred times more efficient to totally cover its cost.

These massive lasers would also have to be fired repeatedly for these inertial confinement-type reactors to be a viable energy source. Right now, the lasers take hours to cool down, making some kind of laser-bombarding power plant (while totally awesome-sounding) completely impossible. Wade thinks a future "inertial containment" reactor could work similar to a car engine, producing several miniature explosions per second. Next steps, according to Wade, are to sustain these reactions for tens of seconds or even hundreds of seconds. The goal of ITER, for example, is to continuously sustain a fusion reaction for at least 400 seconds.

The NIF, along with its tokamak counterparts, are billion-dollar experiments designed to push the very limits of physics (as well as safely test nuclear weapons technology). Although this fusion experiment isn't a direct path to free, unlimited energy, it is a big and necessary step. Just as the discovery of electricity led to a technological revolution, so, too, could this humble experiment one day lead to bottling the stars and powering our world.—*D.O.*

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➤
The Ohio property where treasure hunters believe they've found gold buried by Jesse James.



After Chad Somers saw the vision, he started digging with his bare hands. It was a half-crazy way to get Jesse James's buried treasure, he knew, but he hadn't brought a shovel with him that day, so he just gouged at the soft ground on the hillside. Within minutes he had clawed his way down a foot, then two.

He knew how it would look if anyone had been there to see

him. People would say he'd lost his mind and laugh. And Hope would roll her eyes and say that he was off chasing another one of his obsessive dreams. But Somers was surprised at how easily the shale gave way. He wasn't yet thinking about why that might be the case, or how it all might fit together: the old yard-sale picture, the strange carvings on nearby beech trees, the weird gold-mine legend. That would be later. For now, it was a beautiful day in the summer of 2018, and he was alone in those quiet woods, and there was only him and the oddly permeable soil.

He'd gone there that day, as he had hundreds of times before, to hike and sort things out in his mind. After roaming around for a while, he'd taken a break to smoke a cigarette on a slender ledge hard up against a huge old birch tree, situated two-thirds of the way down the steep, several-hundred-foot bluff. Somers had always noticed that tree. Its base

split off into three large limbs that formed a cock-eyed W, and it stood largely alone, as if it had bought out its neighbors.

Relaxing there, Somers had drifted into a kind of trance—a daydream, is the way he explains it. In the midst of this reverie, he looked over and saw Jesse James sitting next to him—the Jesse James of Old West lore, the notorious bank and train robber. Somers had been thinking a lot about James lately, and now there he was, wearing a round-brimmed duster, flicking ashes from a cigar. He said, “This is where I’m gonna bury it. This is where I’m gonna bury the biggest treasure I ever buried in my life.” Then he got up and walked off, and Somers snapped to. He could hear the creek gurgling below.

Into the breeze, he said, “This is where I’ll dig.”

Somers could never have imagined all that would follow those fistfuls of dirt: the earth-moving machinery and underground scanners; the historian who would join the cause; the rifts, both personal and geological; the way the lens on the entire saga would open wide, then narrow back down, until it once again framed only him—homeless, penniless, but ruthlessly determined—and the hole. Most of all, the hole—the cavity in the earth that would become for him a magnetic force of cosmic proportions, the nexus of his existence.

After a half hour, he'd dug down three feet, and he decided two things. The first was that he was onto something big, possibly the defining project of his



PREVIOUS SPREAD: ALYSE MARKLE USING GETTY IMAGES

life. The second was that it was time to get a shovel.



THE BOWSER FAMILY PROPERTY WAS

an incredible place to be a child. The spread covered more than 300 acres in east-central Ohio, encompassing a farm with hayfields and a home, barn, and bunkhouse. As a girl in the 1980s, Hope Bowser spent long and carefree days there, climbing trees, hopping rocks, picking mushrooms, and camping out. Her brothers often invited their friend Chad Somers along.

That land was divided when it was bequeathed to her generation, and Hope and one brother inherited a more than 20-acre parcel that encompasses a steep, wooded bluff over a creek. She and Chad eventually became a couple, and neither outgrew their attachment to the land. Somers in particular was drawn to it. He spent countless days roaming the property, chattering with the squirrels, watching for bobcats, listening to the wild turkeys warn off coyotes at dusk. He made a study of the trees and the contours of the landscape. “I’ve seen it flowered,” he says, “I’ve seen it flooded, I’ve seen it frozen, I’ve seen it angry, I’ve seen it calm.”

That’s the way Somers talks. His sentences come out as free verse, a sort of Rust Belt beat poetry. At 44, he has straight brown hair, a dramatically creased face, and tattooed arms. The day I meet him, he’s wearing a Chicago Medical School long-sleeve T-shirt and dirt-smudged jeans riddled with holes.

Somers dropped out of school three days into the ninth grade, partly because he had undiagnosed ADHD and couldn’t follow the lessons, and partly because he had so many chores—splitting wood, chopping hay, cutting down corn—that he would have slept through his classes even if he could focus on the schoolwork. He rarely saw his biological father, and spent large swaths of time with his grandparents, to avoid his violent stepfather. As Chad entered adolescence, his stepdad sometimes punched him in the face to assert his authority, but Somers refused to cry or, as he puts it, to “break inside.” This went on until he was 15. Somers was by then morphing into a man who had tasted enough of his own blood. But rather than give in to the urge to fight, he left.

“I’ve been burned to the ground,” he says, “and rebuilt.”

He exudes a shy charisma, but also looks haunted and wary, as if constantly engaging demons both inherited and acquired. Partly to compensate for his lack of a formal education, Somers is an obsessive autodidact. In his late teens he attended a rodeo



OPPOSITE PAGE: Chad Somers points to tree carvings near the dig site. **ABOVE:** Warren Getler references the book he coauthored, *Rebel Gold: One Man's Quest to Crack the Code Behind the Secret Treasure of the Confederacy*.

and became fascinated with bull riding. That night he approached the announcer to ask how he might try riding; the man ignored him, but Somers eventually patched together a Western outfit, climbed onto a bull, and learned as he went. He didn’t mind absorbing lumps. “If I think I can do something,” he says, “I’ll break my back trying.” Over the next eight years he participated in events all over Ohio, until he earned membership in the International Pro Rodeo Association.

“When he gets his mind on something,” Hope Bowser says, “that’s all there is for a while.”

He eventually switched to singing and playing guitar. His grandfather taught him to play “Red River Valley,” and he worked relentlessly until he could perform at open mics and shows. He entered a county-wide talent contest and made the top 10, but a legal problem caused him to miss the finals. In the midst of all this he survived an opioid addiction, a heart attack (he was diagnosed with Wolff-Parkinson-White syndrome, a condition that causes the heart to beat abnormally), and a near-fatal bout of blood poisoning.

Whenever life turned venomous, as it often seemed to, the woods were his antidote. “I always told everybody that there’s something different about this place,” Somers says. “You feel it more than you see it.”

That feeling gained new dimensions in the summer of 2018, when he and Bowser visited a yard sale. They like old stuff, and as they poked through the remnants of an attic, Bowser studied an old photograph of two mustachioed men priced at \$15. There was something familiar about the portraits. “I feel like I know those people,” she said.

Somers went over and picked up the frame. “You know who these people are?” he said. They both agreed that they looked like Frank and Jesse James; Bowser recognized them from her grandmother’s old *Reader’s Digest* books about the Wild West.

Somers showed the portrait around, but their friends and family dismissed it. They insisted the James brothers had never been in Ohio. Somers tried to have the image authenticated, also without much luck, but one collector mentioned an interesting nugget: James the famed outlaw had also been a high-ranking member of the Knights of the Golden Circle, a quasi-military secret society that formed during the Civil War. The KGC opposed the abolitionist movement and sought to establish a new slaveholding state that encompassed the South and



CLOCKWISE FROM LEFT: Warren Getler has always been fascinated by what's hidden underground. Getler says the carvings on this boulder near the dig site offer clues. A purported Civil War battle site map that the team believes points to the treasure on Bowser's property.

Mexico—and legend holds that its leaders amassed a fortune in gold and other precious metals, reportedly in hopes of funding a second Civil War. Some historians claim that KGC stashes of loot remain hidden around the country. According to *Rebel Gold: One Man's Quest to Crack the Code Behind the Secret Treasure of the Confederacy*, a book by Warren Getler and Bob Brewer about the pursuit of KGC treasure, the organization had a central strategy: “to maintain a powerful, hidden base of politico-military operations in the American Deep South, no matter the outcome of the Civil War itself, and with ample treasure to finance them.”

Somers recalled hearing about a local gold mine when he was a kid. It was an alluring story that in retrospect made no sense. According to the Ohio Department of Natural Resources, the only gold ever found in the state were tiny flakes that turned up in streams, having been washed down from Canada. But what if the KGC used a mining operation as a front for a project actually intended to bury gold? That's how Somers connected the dots. “With the whole gold mine theory, what I heard as a kid, holding them photographs—it was like, *I know where it is*,” he says.

His grandfather had run a logging operation, and at times he'd bring young Chad along. Somers recalled a specific episode from one such outing: His grandfather was operating his knuckle boom, and Chad was

watching when a woman on a porch nearby called him over. She told him to keep his eyes open, because Jesse James had buried gold there in the 1800s, and no one had found the treasure. That was right across the road from Bowser's property.

He had to admit it sounded far-fetched that such a treasure would be there, and that he would be able to find it. “We've all seen Indiana Jones—who don't want a whip and a cool-ass hat, right?” he says. “But I never had no dreams about being a treasure hunter.” Yet he needed something to put his mind to. He and Hope had just been evicted from the mobile home community they lived in, where Somers had done maintenance work in exchange for rent.

His James theory consumed him. “Hope was like, ‘Oh geez, shut up about Jesse—not everything's the Jesse James site,’” he recalls. “I think I drove her about half nuts with it.”

Bowser was skeptical, but also curious. “[Chad] thinks differently than most people,” she says. “He sees things that other people look at and don't see.”



SOME OF THE MAP'S SYMBOLS EVEN ALIGNED WITH WHAT SOMERS HAD SEEN ON THE TREES, INCLUDING A TURTLE, A WOLF, AND THE LETTERS "JJ."

Either way, he figured he would find out for himself. Soon after purchasing the yard sale photograph, Somers had his vision and returned to the woods with a shovel. Within a day or so the hole was more than six feet deep, so he brought in an extension ladder and a generator to run a light down there. At around 10 feet down, he was too deep to toss out the dirt, so he fetched a five-gallon bucket that he tied by rope to a root at the tree's base. When the bucket was full, he climbed out, hauled it up, and dumped it. "Repeat process several times until said desired depth is reached," he says with a grin.

Using this grindingly slow method, he reached 15 feet, then 20. After a month, he maxed out the 25-foot extension ladder. He found artifacts, including an old harmonica reed and a cigar butt made from a single leaf of tobacco—both suggestive that someone had been there, perhaps many decades ago.

Occasionally friends came by offering help, then peered into the hole and remembered they had something else to do. Bowser fretted that it might cave in. She asked him not to mention his project socially; people in town ridiculed the undertaking.

"He's like, 'I dug a hole 30 feet in the ground, and I'm standing on a vault of Jesse James's gold,'" she says. "People are like, 'Oh yeah, sure.'"

But he kept finding intriguing clues. Online, he located a hand-drawn map of unknown provenance that claims to identify the location of a large underground Confederate depository in Tennessee on "an 1862–63 Battle Site." But Somers observed that the lettering of the word "Battle" was written in a way that it could be read as "13 oHio"—the 13 perhaps referring to nearby Ohio Route 13 or a KGC symbol. And when Somers turned it to a north-south orientation, the notation "From Nashville" could appear to refer to nearby Zanesville. Somers pulled up a Google Earth image of Bowser's property and laid it alongside the map: The way the features of the landscape form the shape of the letter J was a precise match. Some of the map's symbols even aligned with what Somers had seen on the trees, including a turtle, a wolf, and the letters "JJ."

When he showed this to Bowser, she was stunned. "It was kind of undeniable after that," she says.

Somers had another tool in his arsenal: a copy of *Rebel Gold*. As he searched the woods, he found symbols on the trees—hearts, turkey tracks, turtles—that were identical to the ones described by the authors. "I used it like a Bible," Somers says. "I carried it out in the field with me."

He was 30 feet down in the hole when his shovel gave off a metallic ting. Somers struck a smooth, hard, bluish-gray surface. It appeared to be the top of a vault, but he couldn't penetrate it—every drill bit he tried became stuck.

Before he figured out what to do next, life intervened. He and Bowser were hired to remodel homes in Columbus, an hour away. They relocated into the motels and properties they were fixing up, to be closer to the work, and Somers barely saw the hole for a year. They needed the money, so the job was helpful. But "every day," he says, "I was thinking about it." And he had no idea when he would make it back.



MY FIRST MORNING IN OHIO, WARREN GETLER DRIVES TO THE BOWSER property in a mud-spattered rented Jeep. It's mid-March 2022, and he's come out for a week in hopes of identifying and recovering what he believes could be KGC gold. Today, he is planning to oversee a ground scan using geophysics equipment, to try to zero in further on the potential treasure. The forecast calls for an unseasonably warm day.

Getler is a journalist, geophysics enthusiast, and longtime student of KGC history, having coauthored *Rebel Gold*. He's investigated several sites purportedly connected to the Confederate organization, including one on public land in Pennsylvania where, Getler says, the FBI was allowed by a federal court to dig, largely based on his research. Somers's site is different. It's on private property, which means no interference from government agencies. The hope is that after tests confirm something is there, a crew will commence to "dig shit up." For help, he has summoned his friend Brad Richards, a history teacher whose expertise

in 19th century America helped him land a role on the History Channel show *The Curse of Civil War Gold*, which spanned two seasons. Richards has driven in from Michigan with his 16-year-old son, Bradley.

Wearing a windbreaker and a fraying baseball cap bearing the word WOOF, Getler is a kinetic and youthful man of 61, with a tuft of brown hair. As in his appearances on TV shows, including a guest-star turn alongside Richards on *The Curse of Civil War Gold*, he's intense and excitable—a geyser of detailed explanations filled with rhetorical questions for which he instantly provides answers. At one point, in the course of explaining why he isn't using an underground detection tool called a gravimeter, he offers backstory about another dig. "Well, a gravimeter in this situation—what is the situation?" he continues. "What are we working with in terms of the stratigraphy or the geology? You know what it is—sandstone and shale."

As a child growing up in metro Washington, D.C., Getler became fascinated with fossils he plucked from streams and the woods. When he was 12 and riding the bus as a member of the Annandale, Virginia, travel soccer team, he scanned the sedimentary cliffs of Pennsylvania and Upstate New York and lobbied for bathroom breaks where he believed he might find trilobites. Teammates called him "Professor Brachiopod." Once, during halftime at a playoff game in Ohio, he walked down to a stream and discovered several fossils; he became so absorbed looking for more that he missed the second half.

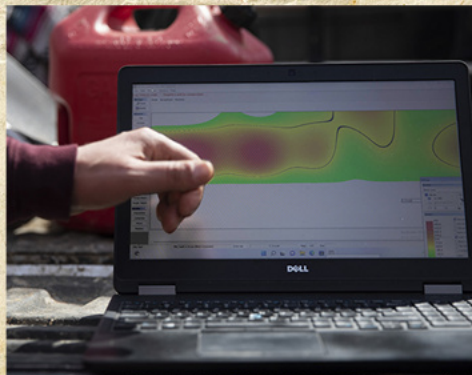
After graduating from Princeton, Getler worked for the likes of the *International Herald Tribune* and *Wall Street Journal*. But he kept at his hobby; his collections of fossils and dinosaur bones grew to the point that classes of schoolchildren came for tours. A duck-billed dinosaur adorned his townhouse window; he displayed a T-rex jaw in his living

room and an ichthyosaurus on his mantel. At an auction, he met the principals of Witten Technologies, a geophysics firm developing ground-penetrating imaging radar. Getler eventually took a job there.

In the 1990s he met Bob Brewer, an Arkansas man who'd spent decades searching for KGC treasure. Brewer had decoded the organization's maps and ciphers to the point where, over the course of numerous hunts, he'd dug up about \$200,000 worth of gold and silver coins. *Rebel Gold*, published by Simon & Schuster in 2003, led to Getler scoring a consultant role on the blockbuster film *National Treasure: Book of Secrets*. His profile elevated, Getler became a kind of consigliere to a small but lively segment of the treasure-hunting community focused on the KGC. Spurred on by his appearances on X-marks-the-spot reality shows, hopefuls with metal detectors regularly seek him out for guidance.

The drive follows several miles of twisting pavement past tumbledown barns and front lawns doubling as auto graveyards. The blacktop eventually gives way to gravel; we pass a ROAD CLOSED sign and climb a steep dirt pitch before pulling into a field. The last half mile is on foot, past lowing cows and lagoons of mud. As we descend a wooded slope, Getler opines that James chose the site for its many helpful attributes: a creek for water, long-living beech trees to bear carved clues, a nearby stagecoach

CLOCKWISE FROM LEFT: Bradley Richards carries a high-powered metal detector down the hillside; a still from an endoscope camera showing buried manmade objects at the dig site; Brad Richards points to a solid mass detected 10 to 12 feet below the surface.



COURTESY WARREN GETLER (ENDOSCOPE IMAGE)

station. From the bluff, he could maintain a lookout for unwanted attention.

Getler leads us to a series of beech trees Somers had identified while roaming the land. He contends that they provide a series of clues—a “story in code”—of James’s activities there. They include an image of a man’s head, which Getler says is both James’s self-portrait and a rudimentary blueprint of the tunnel system, about 100 yards away, where the treasure lies. “There’s a deeper chamber,” he says. “You see it? The rectangle here? That’s our hit.”

Still other trees show rabbits, turkey tracks, hearts, and more. On his first visit several months earlier, Getler saw a faint inscription near the bottom of one tree that, to his eye, reads “Jessie W. James” and the year 1882. “I actually cried,” he says of finding the inscription. “I was trembling.”

Getler contends that this was James’s way of indicating that he didn’t die in 1882 at the hand of Robert Ford, as recorded in history books, but instead faked his death to secretly carry out missions—one of which was burying gold in a hillside in Ohio. “He’s so creative and ingenious,” Getler says.

There will be other clues in the vast, complex, mathematically rigorous system the KGC invented, Getler says. The key, he adds, is pattern recognition—the symbols found here match imagery found in other parts of the country, such as Arkansas, Illinois, Oklahoma, and New Mexico, and KGC records he viewed in the National Archives. “If you have the same symbology appearing—this kind of gets into *Da Vinci Code* stuff, right?” he says. “Then you might be onto something.”

We head to the top of the bluff, where Brad and Bradley Richards are waiting. Bradley straps into a fixed rope for safety on what his father calls the “very, very difficult terrain” of the steep bluff, and begins scanning a 6-by-18-foot grid above the W tree. He uses a Whites TM 808 two-box metal detector, capable of searching for large metallic objects 20 feet underground. That, in turn, is connected to an Arc-Geo Logger, a device that converts the metal detector’s sounds into a heat map that depicts the rough size and shape of a target.

That afternoon, they study the results: a rectangular blob on the Arc-Geo Logger screen that appears to lie 10 to 12 feet below the surface. Richards estimates it’s about eight feet wide and three feet deep, to which Getler barks, “Holy shit!” At that size, he says, doing quick math, the cache could weigh 7 to 9 tons.

There’s no guarantee it’s gold, Richards points out. “But it’s showing metal,” he says.

“And it’s showing it in the place where the ‘Jesse map’ is showing it,” Getler adds.

The group rules out other possibilities: There are no naturally occurring metals here, and it’s an unlikely location to bury scrap. They also speculate that the soft ground and clearing below the

tree may be clues—they suggest a prior excavation.

Somers stops by to look at the image, and fist-bumps the others. “It sure beats digging a hole 30 feet in the ground on a whim,” he says.



LIFE’S INFLECTION POINTS CAN BE TOUGH TO PASS JUDGMENT ON AT FIRST.

A new job can seem like a step forward, but morph into disappointment. Getting dumped from a relationship can be heartbreaking, but ultimately lead to a better match. So maybe it’s too early to categorize what befell Somers and Bowser in autumn 2021. They were rehabbing properties in Columbus; the boss owed them thousands, but kept saying he would make good on the next job. Then he abruptly stopped calling, and stiffed them. Somers lost his tools and they had to forfeit a couple of storage units’ worth of possessions when they couldn’t pay the rent.

The only upside when they scuffled back home was that Somers again had time for his Jesse James project. When he finally returned to the dig site, he found his hole partially collapsed. Rocks pelted him when he clambered down, and the entire enterprise felt far sketchier than he’d left it. Bowser wanted him to stay out of the hole. But Somers, with little else to occupy his obsessive mind, struggled to stay away. “It was driving me insane,” he says. “Like, everything was about the hole.”

Bowser was worried that Somers was setting himself up for another huge disappointment. “I tried to keep him levelheaded about it,” she says. “I hate when he gets sad about stuff.”

On one of his last forays down the hole, Somers noticed something: A few rocks had shifted, revealing an opening. It appeared to be a shaft leading into the hillside. He was pondering his next move when he happened to watch an episode of *Beyond Oak Island*, a History Channel show about lost treasure that featured Getler. Somers decided to reach out. “We need to have a conversation concerning certain KGC maps and what I have discovered here,” he wrote on Facebook Messenger. “Like a concrete vault 30 feet in the ground marked by a giant arrow at the bottom of a giant J where an alleged gold mine once was. Sound interesting enough for you?”

He continued: “If you want the story exclusive we can talk... I’m about to show the world the end of a 200-year-old treasure hunt.”

When Getler called an hour later, his first question was: “How far are you from Zanesville?” His book had documented a Zanesville connection with James.

“I’m about 15 miles away, Mr. Getler,” Somers said.

“Call me Warren,” Getler replied, “and I’m coming.”

They began talking regularly, and Getler made the trip to Ohio about two months after that first conversation.

More evidence of an Ohio-James link turned up in about 20 letters from the likes of Jesse James III, also known as Orvus Lee Howk. One 1948 missive mentions Zanesville and “your look-out at W”—a reference, they believe, to the W tree. In another letter, in December 1948, Howk wrote, “I do know that we are on the right track at W.”

There were also newspaper articles from the *Zanesville Signal*. In 1948, the paper reported that “local kinfolk claimed that Jesse James had once lived here.” The following year, the *Signal* trumpeted a bigger story: A cadre of James’s relatives, including Howk and Roscoe James, Jesse’s nephew, had converged on the area looking for treasure. According to the story, James had gone to Ohio in 1882, after faking his death, and roamed the countryside as J. Frank Dalton, a lightning rod salesman. According to this legend, he lived to be over 100 years old. “The old fellow who claims to be Jesse James has supplied his friends here with a map which is supposed to lead them to a spot, near Zanesville, where

"THERE'S ONE PICTURE...WHERE THERE ARE SIX [GOLD] BARS IN A ROW," GETLER SAYS—OR, AS HE CLARIFIES, "BEAUTIFUL GOLD BAR-LOOKING THINGS."

he buried one and one-half million dollars' worth of gold bullion," the story says. The team recovered only an empty metal box, but reported locating "many strange-looking marks on tree trunks...just where Jesse said we'd find them."

Still, some historians cast doubt on this array of circumstantial evidence, and suggest that the enduring lore of buried KGC treasure has little basis in documented fact. They point, most obviously, to the absence of any major James-KGC stash despite the decades of hunting. In fact, T.J. Stiles, a historian author of the seminal biography *Jesse James: Last Rebel of the Civil War*, says that while it's true the outlaw was deeply involved in the Confederate movement, he uncovered no evidence that James had been in Ohio. "It's not impossible," Stiles says, "but it would have been a rarity, nothing that would suggest he might make the effort to stash valuables there. He strongly identified as a Mis-sourian and a Southerner."

Notwithstanding his mythical place in popular history and the team's fascination with him, James is a troubling figure: a murderer, terrorist, and white supremacist from a slave-owning family who fought and killed in an effort to prevent emancipation. And James liked to spend his money, not save it, Stiles says. "I found absolutely no evidence," he says, "that Jesse James buried treasure."

None of this skepticism has kicked dirt over the enduring torch that multiple generations of treasure hunters have carried for KGC and James-related treasure—Getler and Somers serving as *prima facie* evidence of this phenomenon.

"He was excited, and it really got me excited," Somers says. Propelled forward by their conjoined energy, they navigated out of raging currents of cynicism into eddies of credulousness. True, Somers had done things backwards—he'd dug a hole first, then investigated—but none of it seemed to matter. During that first visit, Getler along with Brad and Bradley Richards took readings—though on less-sophisticated equipment than the TM 808—that confirmed the presence of something underground at the dig spot.

Even when the others left, Somers lingered over the hole. Eager to probe farther, Somers attached a camera to an industrial endoscope—a snake-type device that utility crews use to inspect sewer lines. He

hunkered at the edge of the shaft, working to manipulate the device inside; Bowser perched at the base of the tree, hunched over a monitor, watching the feed and calling down instructions.

This method harvested images that were blotchy and grainy, but intriguing. They showed what appeared to be manmade walls, and a glimpse of something bright and yellow and reflective.



THE HIKE TO THE W TREE FROM ATOP THE BLUFF

consists of a harrowing descent of a few hundred feet down a 75-degree slope. It's daunting enough that Somers put in fixed ropes.

A small group of us—there are two photographers, a videographer, and another reporter on hand—slide down and sit propped up by trees, only to watch Somers gallop down. All this vertiginous navigation raises a key question: How will the 6,800-pound Takeuchi mini-excavator that Getler has hired for the project navigate such a slope? Eventually, Hans Stockli hikes down the slope to provide an answer. He is Hope's ex-husband, a former neighbor, and the friend of Matt Sheets, who owns the excavator in question. "Are you crazy enough to get an excavator in here?" Getler asks.

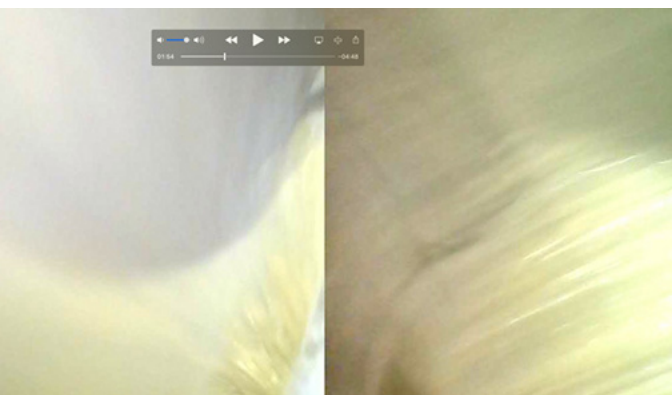
Stockli replies, "My buddy Matt is."

They decide that Sheets will make an angular descent, transecting the hillside. He'll cut a diagonal path, building an embankment on the downhill side as he goes. That afternoon Sheets makes about 50 yards of progress, about a third of the distance he'll need to cover.

As we wait, Bowser takes us to meet Levina Nethers, 86, a lifelong area resident. She recalls being told that her husband's great-great-grandmother provided Jesse James with meals and laundry services when he passed through the area. One day, she informed Jesse that she was facing bankruptcy. "She told him that [the bank] was gonna foreclose on her farm the next day, and she wouldn't be there," Nethers says.

"And he said, 'Don't worry about it, I'll take care of it.'... He came back the next morning and had the money for her foreclosure." She paid off the loan, Nethers says, and the next day, the bank was robbed.

That evening, I ask Getler if he feels a growing sense of anticipation, and he cuts me off midquestion. After 25 years of pursuing KGC history, trying to prove that he's right, he says, this would be sweet



validation, and a career capstone. “Of course I do,” he says. “Do you know how weird it is? Do you know how powerful it is right now?” He holds out a trembling hand.

I ask him what he’ll do first if they find treasure. “Cry,” he replies. “I’ll break down, man. It’s too powerful.”

But the next two days bring scant progress. Sheets makes gradual headway, plowing down saplings and laying them down along the embankment on the downhill side to create a kind of earthen guardrail. Stockli darts in with a chainsaw to clear branches and brush. The slope is denser with roots and topsoil than they’d expected.

Halfway through the third day—scheduled to be my last on site—they have yet to turn the corner toward the W tree. Stockli’s chainsaw gets stuck, and there is a delay involving the excavator’s hydraulic line.

Each setback subtly ramps up the tension. It’s not as if there’s any hurry—whatever’s in the ground has been there for a long time—but this is not an open-ended enterprise. Getler, who is circumspect about how much he’s spending on the project, doesn’t have an unlimited budget. And he took a gamble by inviting a group of journalists along, but he and Brad and Bradley Richards and the work crew have lives, jobs, school to turn back to.

The project is remarkable for its scrappy, homespun approach. But the flip side of that is a real scarcity of resources. There is no government or foundation underwriting a safe, systematic excavation. If Somers and Getler don’t get deep enough into the ground this week, it’s not clear what will happen next.



OCCAM’S RAZOR IS A PROBLEM-SOLVING PRINCIPLE that dates back to medieval times. The idea is simple: If you’re trying to sort through competing hypotheses, you’re better off choosing the one with the fewest assumptions. The most straightforward explanation is preferable to one that’s more complicated. Simple theories are easier to validate.

Adherents to this principle would look askance at Somers’s and Getler’s Jesse James theories. The simplest explanation for what’s found in Bowser’s woods is that some bored or love-crazed teenagers carved images on the trees. The newspaper stories could be written off as reporters airing out local gossip on



OPPOSITE PAGE: Getler sees possible gold bars in this still from an endoscope video recording. **ABOVE:** Chad Somers (below) and Brad Richards examine the hole.

slow news days. If James indeed died in 1882, as was widely reported, there would have been no Ohio treasure-stashing adventure.

Much of what Somers and Getler say about the site comes with heaping doses of supposition—educated guess stacked on hypothesis piled on extrapolation, all of it bracketed by fervent conviction. Wrapping your head around the totality of their case is an isometric mental exercise that creates a sinewy strain between faith and fact.

On one tree, for example, Getler points to the simple etching of a face under a hat. Not only does he argue that this is a KGC marking—“a rebel portrait of Jesse and the hat”—he says it signifies more than it appears to. “It’s not a coincidence,” he says. “That hat is a shaft.”

Getler openly confesses that nothing is certain, and is acutely aware that few people will take any of this seriously until and unless they uncover KGC treasure. “I hope it’s there,” he tells me in one candid moment, “because this is a bunch of crap otherwise.”

But on many other occasions, he whips himself into a state of ecstatic certainty, repeating over and over the various clues they’ve uncovered as if fingering rosary beads. Then he adds, “I know what I’m talking about, because when I know things, I know them,” he says, tautologically. “... I know things that would rock the fucking world if I revealed [them].”

The more of a true believer Getler becomes, the more I wonder why he feels the need to exude such evangelistic vehemence. It's almost as if willing me to believe will make him right. He peppers in implausible claims about the site's significance. "It's getting to the point where it's as curious and intriguing and as amazing as finding something on the Giza Plateau in Egypt"—home of the Great Pyramids—"as far as American history goes," he says. (Somers compares the site to King Tut's tomb.) Other times Getler draws parallels to the Antarctic expedition that located Ernest Shackleton's *Endurance* shipwreck after 106 years in March 2022. But he adds that undersea wrecks are relatively easy to find—the people hunting them often have navigational plotting to follow.

Independently verifying their claims is a tricky proposition. Take the W tree. Birches can live for more than 300 years, but is that particular specimen old enough to have lorded over a James-led treasure burial? Mark Weber, a master arborist based in Dayton, Ohio, says that answering that question accurately would require drilling into the tree to extract a core sample, among other steps. Some really big trees are not as old as you think due to shade, soil quality, and drought or floods, he says.

Adding to the festering sense of uncertainty about the enterprise is the principal characters' embrace of the supernatural. Bowser says she descended the ladder once, and felt so rattled by a dark chill that she had to immediately climb back out. "It was too much," she says.

Getler suggests the reason is that the hole is a source of paranormal activity. The first time he was alone at the site, he says, it exerted a strange pull over him. "Something possessed me," he recalls, "and I felt I was going to let go and fall into the pit."

After hours in the hole, Somers says he saw the walls moving—vibrating. "I'm thinking, I'm too deep," he says. "I gotta get outta here. I'm seeing stuff." Gold is a strong conductor, and he theorizes that it may have been reacting to Earth's electromagnetic field.

There were other strange and unexplained occurrences. A coyote once approached Somers and ignored his

attempts to scare it off. He finally had to fire his .22 overhead to make it skitter away. Another time, a pack of coyotes surrounded his truck when he and Bowser were sitting inside; they dissolved into the night after the couple had a look at the ghostly glow of their eyes. "There is a supernatural element to all this," Getler says. "If you read about this stuff, you'll hear that these treasures are protected by spirits."

Then there's the origin story of Somers's daydream, which led him to believe that this is his life's mission. "I don't feel like I found this thing," he says. "I feel like I was led to it. Like, I asked for help and got it from I don't know where... It doesn't make no sense. But I'm glad."

The sheer mass of circumstantial evidence, combined with their fiercely dogmatic beliefs, has a generative power, inspiring enough of a sense of possibility that I postpone my flight home to spend an extra day at the dig.

After three days, Sheets maneuvers the excavator into position. It's early evening, and Getler announces that they'll finally dig in the morning. Bowser heads off to deal with car issues, and Getler makes dinner plans. I walk the half mile back to my car, hoping for an early start.

FROM THAT EXCRUCIATINGLY enticing moment, though, nothing goes as planned.

Back where we parked, photographer Maddie McGarvey receives a text that the excavation has started—apparently they decided not to wait. We hustle back to find Getler standing on the slope about 15 feet above the site, watching intently as Sheets lifts away bucketfuls of dirt.

Getler says he was surprised, too—he was packing up when he heard the heavy equipment and hurried back. Sheets is already about five feet down; Somers is kneeling, studying the hole, sometimes jumping down inside to inspect the progress.

Despite the abruptness of the moment—liftoff coming unannounced after days of runway taxiing—Getler is ecstatic. "Hans was standing at the tip of the opening," he says. "And Hans says, 'I can see in there—it might be a tunnel.' I

go, 'Yes, yes, yes!'... If he confirms a tunnel, I'm gonna give you a hug, man."

Getler says that now that the process is underway, he's not going anywhere. "I'll tell you what, Chad's not leaving," he says. "He'll stay here all night. I'll stay here all night."

But moments later, two of Bowser's siblings arrive to question the excavation and ask that the project come to a halt until they can clarify whether Hope's brother, the co-owner of the land, has signed off on the dig. Everyone calls it a night to let the family sort it out.

Somers reveals that just before the work stopped, he glimpsed through the wall of the freshly dug hole a hallway with what looked like walls and a ceiling; the tunnel that Getler was so keenly hoping for. But even if the family matter is resolved quickly, definitive answers about the site will have to wait. Brad Richards has to head home—his son has already returned to school—and Getler is leaving tomorrow.

OVER THE NEXT FEW MONTHS, THE project ticks slowly forward. In April, with the Bowser family issues resolved, Getler hires an Ohio firm to run a test on the site using the Sensors & Software Noggin SmartCart system, which examines sites using ground-penetrating radar that scans for voids and buried metal objects. The GPR detects a cache of possible metal that measures 14 feet in length and four feet in width.

In May, Getler recruits a television production company to shoot footage on site, with the goal of pitching a show. He and Brad Richards return, along with Tim Williams, the inventor of the ArcGeo Logger and a veteran of past KGC searches. Williams tells me the data from various technology reinforces the idea that Somers might have made a significant find. "There's definitely something right there," he says.

On that visit, Sheets excavates a second, 15-foot hole next to the first, still a few feet short of the exact location shown on various devices.

The only person who doesn't depart after each of these incursions is Chad Somers, who remains more fixated than ever on the hole. Armed with a shovel, he pushes onward and downward, prob-

ing until, about 20 feet down, he finds several openings into what appear to be more tunnels. Getler and others ask him not to risk exploring these crevices, but Somers can't help himself. He slips into one passageway and crawls about 50 feet before exiting an opening in the hole that had been dug back in March.

During these forays he takes grainy photographs with the snake cam and collects a couple of artifacts: a .38 Special bullet, which could date back to the 1920s, and a bone fragment. He captures images of what appear to be metal urns, a whiskey barrel, and a bracelet, and identifies what Getler—relying on Somers's photos—calls a “fricking huge vault chamber.”

He also spots what may be gold. “There's one picture... where there are six [gold] bars in a row,” Getler says—or, as he clarifies, “beautiful gold bar-looking things.” He later adds, “I'm either right on with my analysis, or I'm crazy.”

Somers says his unscientific analysis from probing and crawling around the site indicates the presence of three underground pyramids on that hillside. He has also found doorways sealed off by manmade blocks. All of this is alluring, but Somers alone, with no heavy equipment, can hardly push much deeper.

In fact, the enormity of the task, and questions over how to proceed, become a point of conflict. Bowser returns to renovation work so they'll have some income, but the couple's relationship becomes strained, in part because Somers would rather chew on aluminum foil than trade in his quest for painting walls or stocking shelves. “*This is my job*,” he says.

Later, he adds, “I'm tired of people telling me that I gotta do more, and suffer more, to reach the goal that seems to elude me.”

Somers is adamant about this approach no matter how dire his situation gets—and during this time, the particulars of his life will become quite dire. His truck breaks down, is impounded, and will cost \$2,500 to recover—money he doesn't have. He moves his few remaining possessions to his grandmother's house, and for a time lives in the crude tarp shelter that he and Bowser erected at the top of the dig site. For a couple of weeks he is stranded there with no vehicle and no data on his phone. He sells off some possessions to

stay afloat, and for a time stays with a friend about 10 miles from the dig site.

“At the age of 43 [now 44], here I sit,” he says. “Homeless, no vehicle, in worse shape now than I was when this project started.”

Even more alarming, Somers has responded to the feel of the wall on his back by pushing everyone else away. Somers has lashed out at Getler repeatedly, over an array of issues; he believes that Getler has at times taken credit for his discoveries and exerted undue control over the project. For months, they were locked in a disagreement over a fee they were paid by the TV production company. Most of all, Somers chafes that Getler is choosing a conventional livelihood over working in the dirt alongside him, saying that he lacks “the grit or the determination or—let me put it plainly—the hunger.”

Getler, though, says he has invested plenty of himself into the project, including thousands of dollars both on the excavation work and keeping Somers afloat. In his ferocious dedication to proving his version of history, he's equally obsessive. He sounds like someone doing his best to cling to the project's curves as it careens into ever more uncertain territory. The possibility of finding treasure makes it worth the calculated risk, he says. “This would be absolutely historic, beyond anything you've seen in your life.”

But he refers to Somers's mindset as “fanatical” and calls him “stubborn” and “not rational or reasonable.” And he worries that Chad will venture into the hole one time too many and get himself trapped in there, literally or metaphorically—Ahab consumed, finally, fatefully, by his white whale.



BY LATE SUMMER, THE RHETORIC COOLS, and the principals agree that Somers will stay above ground while Getler looks for a funding source—ideally a TV project that will both underwrite and chronicle the rest of the dig. And in late 2022, Somers and Getler signed on with Mark Wahlberg's production company to pitch a television series. That blows some wind into their sails, but it won't deliver any game-changing infusion of cash unless and until a network or

streamer like Netflix agrees to fund it.

Through all of this, Somers remains fixated on the hole. He describes the situation as being “in limbo,” clearly referring to both his hole and his life, because they've become almost interchangeable. Given the unknowns, it's hard for some to comprehend his mulishness. Why not just get a job for \$18 an hour, have a roof overhead, and visit the site on weekends and evenings until financing is in place?

Not Chad. This started with a hole he dug by hand, and there is a terrible beauty in the purity and all-consuming nature of his quest. Of course it makes more sense to get a job, to take the safe and prescribed approach. But what has that ever done for him? He's been beaten down, gifted, laughed at.

Once, hanging out on top of the bluff, I ask what it would mean to him to find Jessie James's buried treasure. Somers is deeply self-deprecating, but he is also prideful. He says there are people who use money to build towering shrines to their own selfishness, and there are others who “never had nothing and they end up with something, and usually by the end of it they have nothing again because they helped everybody that's ever helped them, or that they cared about. I mean, if I die with even \$2 in my pocket, I did something wrong. I think that that's what I'm supposed to do.”

But he doesn't stop there. For all his backwoods eloquence, it's not hard to detect the heavily worn shoulder chip of a man who has something to prove. “I wanna just write my name in that book,” he says. “That one that people look at and go, ‘This dude did something really important.’ And I guess that's probably what means the most.”

Money matters. Of course it does. Finding a cache of lost gold would put so many worries to rest. But for Somers, it would still be the second most important thing.

Something is down there. There's too much scientific evidence now in place to deny it. And the truth about what lies inside that Ohio hillside will emerge, maybe later this year. Until then, Somers will suppress his urge to claw deeper into the earth. But in every other meaningful way, he'll remain down in that hole until the last shovelful of dirt has been turned over. 



After
You Die,
MONICA
TORRES
Can
Bring Life
BACK TO
Your Body

44 March/April 2023



The groundbreaking mortician is pioneering new techniques to restore the dead and provide closure to grieving families.

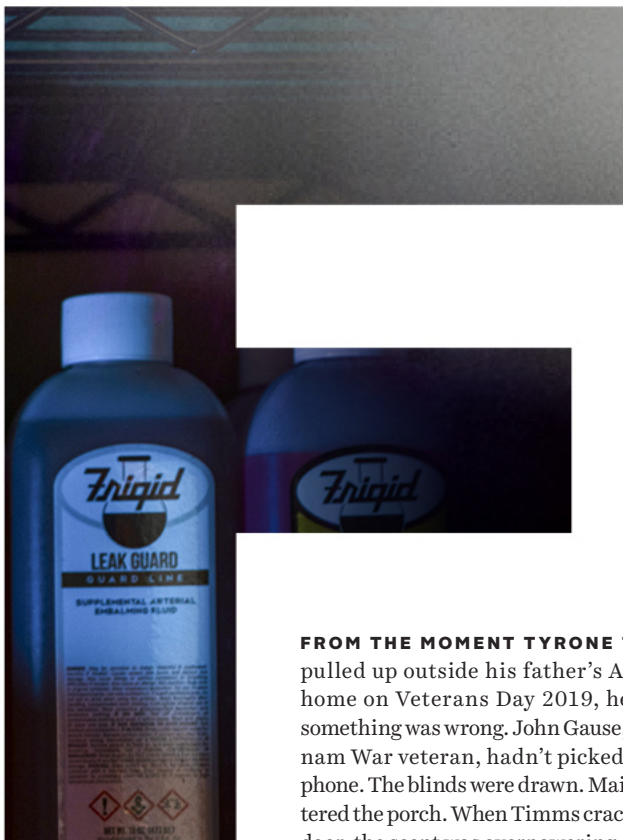
By ELEANOR CUMMINS / Photography by ASH PONDER



✦ Arizona-based Monica Torres is pushing the boundaries of mortuary science.

➤ Embalming fluid can include preservatives like formaldehyde, alcohols, dyes, detergents, and disinfectants.





FROM THE MOMENT TYRONE TIMMS

pulled up outside his father's Arizona home on Veterans Day 2019, he knew something was wrong. John Gause, a Vietnam War veteran, hadn't picked up the phone. The blinds were drawn. Mailers littered the porch. When Timms cracked the door, the scent was overpowering. A body was lying in the hallway—his father's, now unrecognizable due to decomposition.

Gause's remains were turned over to the Maricopa Medical Examiner for autopsy. The results indicated he died of natural causes, roughly four days before Timms found him. Their investigation complete, the medical examiner released Gause's body to a local funeral home. In a tiny planning room at Thompson Funeral Chapel, Timms and his family asked for the seemingly impossible: Could they have an open-casket service?

That's how Timms met Monica Torres, a Phoenix-based embalmer, funeral director, and reconstruction specialist. Torres, a 5-foot-2 Latina in her 40s, stands out in her colorful dresses and partially shaved head in a field still dominated by older white male funeral home owners in three-piece suits. When funeral homes have a tough case, it's Torres who picks up the call.

Torres is a visionary in the end-of-life industry and a specialist in traumatic deaths: miscarriages and murders, car crashes and suicides. Over the last decade, Torres has launched what she calls her "dark arts" into an internationally recognized brand with more than 27,000 Instagram followers who know her as "Cold Hands." By day, Torres leads continuing education classes for embalmers around

the world. By night, she drives from one funeral home to another with her wheeled embalming kit, restoring bodies in the perfect quiet.

While Torres sees embalming as a spiritual calling, the practice is not without its critics. The work is built around formaldehyde, a carcinogen. Its use can have negative consequences for the health of the embalmer, and of the environment in which an embalmed body is buried. Green funeral advocates push for more presumably eco-friendly options, such as direct cremation, alkaline hydrolysis, and human composting, widely believed to be the future of the American funeral industry.

But for those who still want to be embalmed—a demographic that in the United States includes many Catholics, Black Americans who uphold the homegoing tradition, and those whose loved ones are damaged beyond recognition—Torres is their greatest ally. "Families do want this and they do find value in it," she says of embalming. Whether it's Torres or one of her former students in the prep room, she wants to ensure all of her clients get the quality service they deserve.

So when Torres sat down with Timms that mild November day, she gave him the standard disclaimer: There are no promises in her line of work. Every body responds differently to the embalming process, and even the most skilled technicians can accomplish only so much under a time crunch. "I didn't pull any punches," says Torres. "This is invasive surgery." But she told him she would try her best. She had just 72 hours to make it work.



EMBALMING DATES BACK AT LEAST 4,500

years to ancient Egypt. Ritual mummification was meant to help the deceased navigate the journey to the afterlife; it also ended up preserving their remains for thousands of years. But modern techniques, which aim not only to preserve the dead but to make them appear as they did in life, emerged only 160 years ago. In the U.S. Civil War, roughly 620,000 men—or 2 percent of the total U.S. population—were killed, often hundreds of miles from their families. Loved ones paid surgeons to identify the remains of their fallen soldiers, embalm them, and ship them home for a proper burial.

At first, embalming was a practicality. But in the wake of the assassination of President Abraham Lincoln, embalming became seen more and more as a cultural inevitability. In the two weeks after his death, Lincoln's embalmed remains traveled by rail from Washington, D.C., to his home of



Formaldehyde, a known carcinogen, is still a key ingredient in embalming fluid.

Springfield, Illinois, for burial. The train stopped in 10 cities along the way, allowing an estimated 1 million Americans to see their slain president's hardened, bronzed, but nonetheless recognizable visage. Eventually, many of these citizens would choose embalming for themselves.

The quality of embalming has advanced dramatically since Lincoln's day, but the goals remain much the same: help this person look good for the very last time. For Torres, the process starts when she walks into the prep room and dons a full-face respirator, surgical gown, and nitrile gloves. Epidemiologists say dead bodies are generally safer than living ones, but interacting closely with human remains can still lead to the spread of pathogens like hepatitis, tuberculosis, and COVID-19. In addition, the embalming process itself carries risks due to the toxic chemicals that could be inhaled.

Next, Torres removes the naked body from its vinyl

bag and lays it out on a steel embalming table. The head is elevated to prevent blood from pooling behind the ears, which could leave the skin dark and discolored. Moving 360 degrees around the remains, Torres notes the consequences of death that will affect her approach. If there has been an autopsy, the organs are embalmed separately and placed back into the abdomen. She looks for other open wounds (which leak if not properly sealed) and medical devices like fentanyl patches (which could be dangerous if touched bare-handed).

After Torres assesses the state of the remains, and begins plotting their restoration, she vigorously scrubs the entire body with water, antibacterial soap, and disinfectant. The extra effort goes a long way; Torres says that many of the odors of decomposition actually waft off of the body's surface. Usually, they're coming from the same places that stink in life—like the genitals, armpits, mouth. She then gives the teeth one last brush.

With the cleaning complete, Torres uses reference photos to set the facial features in a peaceful expression. She places tiny plastic domes under the eyelids to keep the eyes closed and seals the mouth using either a surgical needle and mortuary suture or injectable feature builder and a chemical stabilizing agent.

Now, the real work of embalming can begin. Torres first makes a small surgical incision just above the collarbone, locates the carotid artery, and raises the vessel to make an incision that will allow her to access the entire circulatory system. She inserts a medical instrument called an arterial cannula and clamps the vessel to secure it in place. The cannula is connected by hose to a small embalming machine, which looks almost like a drip coffee maker, but holds a customized preservation solution (often formaldehyde) as well as other tinctures, including humectants for rehydration and loosening coagulated blood. As the machine pumps the solution into the arteries, the formaldehyde interacts with the proteins inside, causing the corpse to stiffen. (You know you're done, one embalmer told me, when the body's consistency goes from a soft-boiled egg to a hard-boiled one.) Torres then ties the artery off, and sutures the incision closed.

With arterial embalming finished, it's time for Torres to embalm the body cavity. As the dead decompose, naturally occurring microbes in the stomach begin feasting on their remains, pro-

ducing gases and liquid as they go. To stop the body from swelling, Torres makes a small incision near the belly button and inserts a 2-foot-long hollow device called a trocar. Once it's in place, she aspirates any organs inside, drawing white fluid from the lungs, red fluid from the heart, yellow fluid from the bladder, brown fluid from the intestines, and so on. Torres then uses the trocar to flood the abdomen with embalming fluids, before sealing the body once again. With nothing left to decompose, the risk of further bloating is gone.

In cases of trauma, restoration comes next. Depending on the individual's needs, Torres may cut away excess tissue in the mouth to reduce signs of swelling, craft new noses or matching ears with embalmer's wax, or graft hair from the back of the head to restore the hairline—a procedure she pioneered. Torres often injects dermal fillers, conceptually similar to ones you might find in a plastic surgeon's office, to plump the deceased's lips and cheeks or give the skin a youthful appearance. "There is a great deal of troubleshooting," Torres says. At every step, she makes adjustments, until everything looks just right.

In the home stretch, Torres focuses on final touches: the little things that make someone not just recognizable, but beautiful. Embalming fluids are often dyed to help match the deceased's natural skin tone. Specialized mortuary makeup can also help. The creams are thicker than what you tend to find in a Sephora, and specifically designed for cold skin. However, personal makeup is often used to customize the final appearance. Torres will also style the deceased's hair and nails, dress them in their finest clothes, and casket them. "[Torres] will actually take the time to give somebody a full manicure," says Elizabeth Fournier, an Oregon-based funeral director. "She doesn't cut corners."

The entire embalming process can take as little as an hour. But if someone's remains have already begun to decompose, like Gause's, or have been subjected to treatments like chemotherapy, a stan-

dard formaldehyde solution won't cut it; the body has changed in ways that make it harder for the bonds between proteins to form. So Torres turns to more powerful embalming fluids, some of which could clear out the room with a single drop. Each fluid has to be given the time to do its work, so the process can stretch on for days, or even weeks, as Torres continually tweaks the balance of chemicals until she's struck the perfect balance between wet and dry, soft and hard.

If nothing else, this might be a good time to rest. But when it comes to complicated cases, no one can say for sure how the body will look in the morning. "You're dreaming, what can I do, what will work?" Torres says. "That worry never leaves."



IN THE SUN-BLEACHED COURTYARD OF PHOENIX'S

Heard Museum, a space dedicated to American Indian art, Torres sits drinking a pink prickly pear lemonade. As a child, Torres loved Frida Kahlo—a strong woman, unflinching in her intimate portrayals of the human body. For her own part, Torres liked to draw skulls. Each fall, her parents would bring her to the Heard Museum for its annual Día de los Muertos—inspired celebration, where masked figures called *calacas* play music and dance, children make paper marigolds, and everyone eats a special sweet called Pan de Muertos, or "Bread of the Dead."

Death surrounded Torres from an early age. Looking back, she believes it was likely the untimely passing of her father, Raoul "Bully" Torres, that put Torres and her brother Israel, a labor lawyer, on their respective career paths. In 1978, in Torres's hometown of Silver City, New Mexico, Bully was crushed by a truck in an accident at a mining site, along with several of his fellow laborers. He died and his remains were horribly disfigured. Torres was just 9 months old.

Despite the extent of the damage to her father's remains, a local funeral director agreed to embalm Bully for an open-casket funeral. It wasn't a perfect job, but the small community was moved by the effort.

With every death, Torres seeks to center the body. It's her conviction that this the presence of the loved one in the death ritual is what helps families heal.

Torres predicts more change is on the horizon. For instance, future funeral directors may be able to 3-D print life-like body parts for their restoration work, whether it's a left ear or an entire face.

"Really the only connection I had to my dad was other people talking about his funeral," Torres says. At school or the grocery store, people would stop her and say, "Oh, you're Bully's daughter. I was at his funeral."

Even so, Torres never set out to be a funeral director. As a teenager, she was drawn to cosmetology of the living. By the time she finished high school, she had her nail technician's license, and started her own spa shortly after graduation.

When Torres was 21, her grandmother died. The funeral director offered Torres and a few of her family members the chance to style their loved one's hair and do her makeup. "When it came down to it, it was harder, I think, than everyone anticipated," Torres says. While her cousins, aunts, and mom ended up standing back, Torres says interacting with the body felt "natural." Her grandfather, who was also in the room, directed Torres as she went, making sure she added her grandmother's signature mole on her cheek. "That was the first time that I realized this is someone's job," Torres says. "Somebody is trained to offer this kind of care."

Life continued pushing Torres closer toward "working hand in hand with death," she says. After her grandmother died, Torres discovered photos tucked away in her mother's garage, showing her dad in his casket. "At that moment, I got closure I didn't even know I needed," she says. "All the stories I'd heard, they started to make sense." But other things called her attention, including her new role as a military wife, which kept her moving from base to base for the better part of a decade.

It wasn't until Torres was in her late 30s that she finally took the plunge and enrolled in a Phoenix-area mortuary school for a two-year degree program. Initially, Torres marketed herself as a specialist in desairology, the technical term for cosmetology for the dead. Her work in the salon had given her a good foundation in color theory, which is critical to creating a lifelike palette for people of all skin tones. As her career progressed, Torres began to take on more complicated embalming cases.

Throughout her training, Torres noticed that other funeral directors were often too anxious to innovate—the stakes are high, after all, and people tend to stick

with what they know works, especially when time is limited. But Torres was an eager experimenter, always finding new and hopefully improved ways to get the job done. She has since gone on to invent her own hair-grafting technique, a new tummy tuck strategy, a means for sealing bodies without embalming, a wax-free restoration method, and more. "[Each one is] inspired by a family that I served that has suffered a loss," Torres says, "and I'm faced with a new challenge." So she finds her own solution—and makes it a point to teach others.

In 2014, Torres started her own trade embalming company, NXT Generation Mortuary Support. The premise was simple: When other funeral directors didn't have the time or expertise to embalm a traumatic death, Torres would do her best to save the day.

Two years later, the Catholic Church's Phoenix diocese offered Torres a position managing a funeral home—Holy Cross Catholic Cemetery and Funeral Home in Avondale, Arizona. Although she had to put NXT on hold, the opportunity allowed her to try her hand at every aspect of deathcare, from working with families in the throes of mourning to supervising the exhumation of long-buried bodies. More than anything, the experience taught her she never wanted to own her own funeral home. Torres says she couldn't stomach the enormous liability, and saw others struggle with the balance between work and personal life.



CHANDLER-GILBERT COMMUNITY COLLEGE IS the only mortuary school for 300 miles in any direction. On a blisteringly hot day in early August, the campus, which sits about 30 minutes southwest of downtown Phoenix, is quiet, save for the singing cicadas. It was at this program that Torres learned her trade. The next class won't arrive for another few weeks. When they do, they'll be diving into the deep end of a rapidly changing field.

Embalming, which once took center stage in the American funeral tradition, is now widely understood to be toxic, thanks to formaldehyde's



✓ Torres holds a trocar, which she uses to drain fluids from the body cavity.

Tools of the Trade

IN ADDITION TO FORCEPS, NEEDLES, AND SCALPELS, MORTICIANS USE A VARIETY OF SPECIALIZED TOOLS TO PREPARE THE DEAD.



1. Aneurysm Hook

→ This instrument lifts arteries away from the connective tissue holding them in place to provide quick and easy access to major blood vessels.



2. Arterial Tube

→ When inserted into the decedent's arteries, the arterial tube flushes blood from the circulatory system, making way for embalming fluid.



3. Embalming machine

→ Essentially a pressure pump, this device pushes blood out of the body and embalming fluid in. Many machines have a setting that mimics the heart, sending pulses of liquid into arteries.



4. Hydro Aspirator

→ Near the end of embalming, this instrument flushes remaining bodily fluids from the abdomen and can alternately rinse and vacuum liquids via water pressure.



5. Trocar

→ Connected to the hydro aspirator via a rubber hose, this long, hollow rod is inserted into the abdomen and organs to drain them of remaining fluids.



6. Eye Caps

→ Ridged eye caps slipped beneath the eyelid—one of the body's thinnest skin membranes—prevent dehydration and seal the eyelid. If the patient has donated their eyes, multiple eye caps can be layered.



7. Mouth Former

→ These tools can be placed in the mouth to give the lips a more realistic shape—often used when the decedent used dentures or lost teeth.

starring role. The risk is not to the family members viewing the body, but to funeral industry workers. Embalmers are more likely to develop leukemia, ALS, and other diseases at higher rates than their peers in other fields, according to a handful of peer-reviewed research studies spanning more than 20 years. The most plausible explanation is chronic workplace exposure to carcinogens.

Now, it seems that such contamination can leak over into cemeteries, too. In the U.S., something like 800,000 gallons of embalming fluids are buried each year. While there are few systematic studies of the risk, formaldehyde has the potential to contaminate the soil and groundwater in and around cemeteries, according to Fournier, author of *The Green Burial Guidebook*. The environmental threat appears to lessen over time; by about 10 years after burial, any formaldehyde at a burial site is so diluted as to be harmless. But newly embalmed bodies are buried every day.

Yet many people continue to turn to embalming as a matter of tradition. For example, many Black Americans elect for a “homegoing”—a celebration marking their return to heaven. While homegoings predate modern embalming techniques, today they typically center on an open-casket presentation of an embalmed body. By dressing the dead in their finest clothing, styling their hair, painting their nails, and repairing any evidence of hardship or traumas met in death, funeral directors can offer the deceased dignity.

Families with loved ones who die traumatic deaths may gravitate toward embalming for similar reasons. Torres often works with people who said goodbye to a spouse or a child in the morning, and never saw them again—except, perhaps, to identify their body in a morgue. For these clients, embalming may be the only thing that allows them to reconnect, for a final time, with their loved one.

For Torres, the emotional benefits of embalming outweigh any of the risks. So she masks up and gets to work. But while Torres is particularly passionate about embalming, she says she would never try to convince a family that it was right for them. There are instances where even Torres finds herself telling a family not to view a traumatic case, and instead rely on their happiest memories of that person alive. With every death, Torres seeks to center the body. It's her conviction that this—the presence of the loved one in the death ritual—is what helps families heal.

Emerging research lends credence to Torres's claim. There are few studies evaluating the role

of funeral rites in metabolizing grief, says Christy Denckla, PhD, a grief researcher and assistant professor of social and behavioral sciences at the Harvard T.H. Chan School of Public Health. What we do know is that avoidance—especially in cases of traumatic deaths—can increase an individual's odds of mental illness. Embalming and open-casket viewing are one way for people “to confront the loss, assimilate the loss, and reconcile a reality of a future without the loved one in it,” Denckla says.

No way of mourning is necessarily better than any other, says Robert Neimeyer, PhD, a clinical psychologist and director of the Portland Institute for Loss and Transition in Oregon. “Virtually anything that honors the dead will assist us in our grief,” he says. What’s most important is that the living feel they have agency as they process their loss. “The choice made by the family to do all that one can also helps confront the powerlessness of a traumatic death,” Neimeyer says. Whether a family chooses embalming and burial or a direct cremation, being able to make that choice can be healing.

Americans have more choice than ever. Flame cremation was almost unheard of before 1960; now, almost 60 percent of families opt for it. Twenty-six states have legalized alkaline hydrolysis, which dissolves a body in a matter of hours using water, lye, and heat. And in an era defined by the climate crisis, green burial and human composting speak to eco-conscious customers.

These emerging methods are often defined in contrast to the traditional funeral and burial—and against embalming in particular. But nontoxic embalming fluids could help bridge this divide. Chemicals like glutaraldehyde work almost exactly like traditional methods, but they’re not carcinogenic. Some are even approved by the Green Burial Council, which otherwise requires that anybody interred in a green cemetery skips embalming, casketing, and the like. Yet many funeral directors remain skeptical of these alternative chemicals, and are poorly educated in their use, Torres says. Similarly, customers who want eco-friendly options tend to forgo embalming altogether, while those who really want to be embalmed don’t worry themselves over what materials are used.

Torres predicts more change is on the horizon. In the future, funeral directors will be able to 3-D print lifelike body parts, whether it’s a left ear or an entire face. Plastic surgery will continue to inspire new procedures for deathcare. After a pandemic bump, transhumanist technologies, ranging from simple digital memorials to holographic representations

of loved ones, will grow in popularity. And while Torres loves embalming and believes nontoxic approaches will gain traction, she thinks green burial methods will ultimately reign supreme.

Since working 20-hour days at the height of the Covid pandemic, Torres has begun trimming her client list and refocusing on her growing role as a mentor to other female, nonbinary, and transgender embalmers, who will take care of families like Gause’s when the wear and tear on her body means she can no longer do the work herself.



TORRES WORKED TO RESTORE GAUSE’S BODY

almost up to the minute Timms and his family arrived for the viewing. The biggest challenge she faced was a phenomenon called skin slippage. When a body begins to decompose, the cells holding the layers of skin together start to separate, and the top can slide right off, pulling hair and other features along with it, and make bodies unrecognizable. For three days, Torres used different chemicals, preserving Gause’s body with formaldehyde, combating odor with essence of clove, adding suppleness via hydrating agents to give his remains a lifelike color and texture. Finally, she tucked his hair beneath a veteran’s cap.

With Timms’s permission, Torres documented every step of Gause’s embalming, so she could turn his case into a continuing education class—her own way of memorializing Gause. Thousands of embalmers have since learned how to apply the same methods to their own difficult reconstructions. Though it’s a technical course, Torres’s primary objective is psychological. To take on a case this challenging, she says, “you have to be able to overcome fear” of failure.

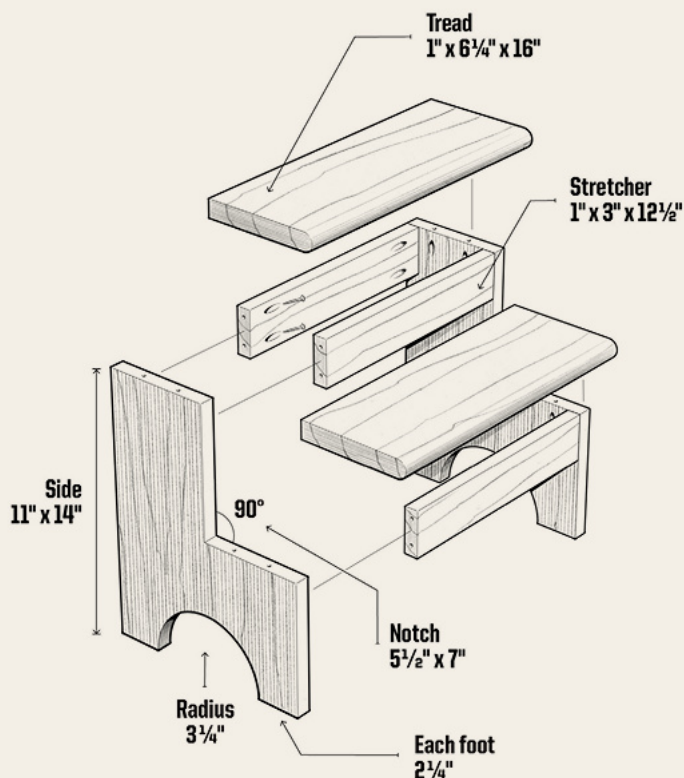
When Timms, a tall, lean man of 55, entered the chapel on the day of his father’s funeral, his own body was tense with trepidation. He had no idea what he would see—and he was still tormented by the sights and smells of the day he found Gause dead. But when Timms’s half brother, Shawn, looked down at the casket and saw his stepfather’s face, “it was a relief,” he says. “He looked like he was sleeping peacefully, as he should be.” Others in attendance were vocal in their surprise—hadn’t Gause been decomposing for days? How could he look so good? So young?

To this day, Timms says he struggles with post-traumatic stress as a result of his father’s death. But when intrusive memories of discovering Gause’s body resurface, Timms says he now gets the choice to focus instead on the memories of his father as he appeared in his casket. 

HAVE SOME
SCRAP WOOD?
**MAKE
THIS DIY
SHAKER
STEP
STOOL**

BY JOE TRUINI | PHOTOGRAPHY BY HENRY HUNG





TOOLS AND MATERIALS

- ☐ Miter saw
- ☐ Benchtop table saw
- ☐ Jigsaw and blades
- ☐ Compass
- ☐ Pocket screw guide and screws
- ☐ Cordless drill
- ☐ Primer-sealer
- ☐ 220-grit sandpaper
- ☐ Tack cloth
- ☐ Paint
- ☐ Satin polyurethane

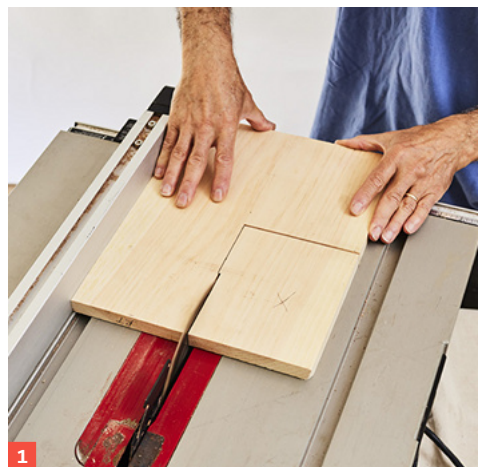
WHAT YOU'LL NEED

We built this little stool using just a few common tools and some scrap wood. For accurate crosscuts, we recommend using a miter saw. For the notch, a table saw is the better choice. However, if you cut carefully, you can make both types of cuts with a circular saw, particularly if you guide it along a straightedge clamped to the workpiece. We used 1 x 12-inch pine (actual $\frac{3}{4}$ x 11 $\frac{1}{4}$ -inch) and old stair treads to build the stool. If you opt not to use stair treads, you can swap

in red-oak lumber, but you'll have to use a router and bullnose bit to achieve the rounded edge on each tread.

GET STARTED

Use the table saw to rip the two sides to 11 inches wide. Next, crosscut them to length and mark the notch in the pieces. Before making the cut with the table saw, raise the blade above the workpiece by about $\frac{1}{4}$ inch and place the inside face of the workpiece against the saw table. Next, cut right



up to the point of intersection where the two cut lines meet [1]. When you flip the workpiece over, you'll find that the saw blade has slightly overcut the intersection. (You won't see this once the step stool is assembled.) After you make the second notch cut, the waste piece should drop away. If it doesn't, finish the cut with a jigsaw or a hand saw. Note in the photo that we adjusted the saw's fence so that the saw blade cuts just on the waste side of the reference line.

Using a compass, mark the arch-shaped cut line on the outside surface (this is the side that will be visible when the stool is built). Use a jigsaw and 10-tpi (teeth per inch) reverse-pitch wood-cutting blade [2]. This blade leaves a very fine finish and produces little or no splintering.



Crosscut your stretchers to the length shown in the drawing and bore two pocket screws at the ends of each [3]. Also bore a pair of pocket screws through the back of the sides at each tread location. Now you're ready to paint and assemble.

Lay the parts down on a drop cloth or some masking paper, and apply a coat of shellac-based primer-sealer [4]. The Zinsser BIN primer that we used works particularly well on pine, which may have the occasional pocket of pitch or a small knot that will show through the paint if it isn't sealed. Depending on the temperature and humidity level of wherever you're working, the primer will dry in anywhere from 15 to 30 minutes. Sand the primer coat with 220-grit sandpaper and wipe off any dust with a tack cloth.

After you wipe the parts down, top-coat them with two layers of spray paint (we used Behr Surf Spray). Be careful to keep paint off the end grain of all the parts; if you don't, it could prevent the pieces of wood from fitting tightly together. Next, rip and crosscut the treads to the dimensions shown in the illustration and apply two coats of satin polyurethane to them. Sand the first coat with 220-grit sandpaper, wipe it down, and apply the second coat.

When both the paint and polyurethane are dry, assemble the bench by driving 1¼-inch pocket screws through the stretchers into the sides [5]. Then flip the bench and drive the pocket screws through the sides into the treads. Now that old scrap wood is being put to better use. **PM**



IMPLEMENTS of CONSTRUCT



TOOLS ARE IMPORTANT. WE NEED THEM TO WORK ON OUR HOUSES, FIX OUR CARS, AND WHIP OUR YARDS INTO SHAPE. BUT THERE'S ANOTHER ASPECT TO TOOLS: WE LIKE USING THEM. EXPERIENCING THE POWER TO WORK FASTER, MORE EASILY, OR WITH GREATER ACCURACY IS DEEPLY SATISFYING BECAUSE THE TOOL IMPROVES THE PROCESS AND THE RESULTS. IF YOU FEEL THE SAME WAY, READ ON. WE HOPE ONE OF THESE WILL HELP YOU ENJOY YOUR NEXT PROJECT.

TION



↑ BEST VALUE DRILL-IMPACT DRIVER KIT

Ryobi PBLDD01 \$199

The PBLDD01 isn't as fast as a contractor-duty tool (it did hang up many times at the bottom of the hole). But the fact that a DIY-grade hammer-drill made 49 one-inch holes through framing lumber in our test without much complaint is pretty remarkable. In terms of value, it's hard to beat because it comes with an equally spunky impact driver.

← BEST CORDLESS TRACK SAW

Ryobi PTS01 \$299

We've learned one thing from testing track saws in the last year: We like them a lot. And there certainly is a lot to like in this easy-handling, 18-volt saw from Ryobi, a power tool priced for homeowners and hobbyists that's capable of doing very smooth, straight, and accurate cuts. The kit version of the saw comes with a two-piece, 55-inch track, a 4-Ah battery, and a charger. It's more than enough capability to help you knock out a plywood shelving project.



↑ BEST JIGSAW

Bosch GST18V-50N \$149

Bosch has long held a commanding position in jigsaws because it has given this power tool attention in a way that other manufacturers have not. That institutional expertise explains why this jigsaw cuts wood and metal so smoothly and easily, without vibration or even a lot of noise. The GST18V-50N is also equipped with a dust blower, a work light, and tool-free access to install and remove blades.



↑ BEST RECIPROCATING SAW

Denali ARS5829B \$90

We're reciprocating-saw connoisseurs here at *Popular Mechanics*. What we aren't are snobs. There's plenty of room in the DIY market for a sturdy little reciprocating saw, as this 4.8-pound tool demonstrates. We used it to make fast, vibration-free cuts in Douglas fir framing lumber and were pleasantly surprised by its power. The kit (saw, battery, and charger) also comes with three blades: one for metal, one for wood, and one for pruning branches.

↑ BEST OSCILLATING MULTITool

Bosch GOP18V-28 \$119

Here's what you get with Bosch's new oscillating multitool: accurate dial-adjusted speed (8,000 to 20,000 oscillations per minute). It's also powerful (with a fresh wood blade chucked in, it buried the blade to its full depth in seconds). The Bosch's well-shaped handle and good weight distribution make it easy to operate. Finally, its accessories click on and off effortlessly.

↑ BEST ANGLE GRINDER

Bosch GWS 18V-8 \$139

Equipped with a 2.5-Ah battery, this 4½-inch angle grinder weighs just 5 pounds—a fly-weight in the world of these tools. We found that its lightness and lack of vibration make it perfect for small cutting and grinding jobs. Amateurs and professionals alike can appreciate that. Also notable: The guard rotates easily and without tools.



↑ BEST CORDLESS SANDER

Bosch GEX 18BV-5 \$109

Standing just 4½ inches tall, this 18-volt sander is one of the lowest-profile models we know of, about equal to those powered by compressed air. That's handy when sanding inside a piece of furniture. It's also very light; with a 4-Ah battery, it weighs 3.6 pounds. It sands very quietly and nicely, with six speeds. Its dust collection, via a screw-on bag, is about as good as we've seen on any sander, cordless or corded.



↑ BEST POWER BANK

Milwaukee 2845-20 \$699

To test Milwaukee's power source, we plugged in a 15-amp worm-drive Skil circular saw and went to work cutting framing lumber. No problem. Balance and weight also checked out. Of course, it also charges power tool batteries and has multiple outlet ports for running more than one tool at a time or in sequence.

↓ BEST TABLESAW

SawStop CTS-120A60 \$899

SawStop has become famous, and justly so, for the technology that stops its table saw blades instantly on making contact with human skin. This compact model is equipped with the company's famous finger-saving technology, which brakes the blade if it comes into contact with skin. It's among the best small saws we've ever used due to its power, an easily installed riving knife and blade guard, and a rack-and-pinion fence that is dead-on parallel to the blade.



↑ BEST ABRASIVE TOOL

Restorer WR351K2 \$170

Restorer is an apt name for this. It's a power drum sander-grinder-polisher. If you need to strip paint off metal or wood, grind the surface of salvaged lumber before running it through a planer, or polish something you welded together, the Restorer will do it. Just use the adapter to connect it to a shop vacuum: Its output is prodigious, and you wouldn't want to be breathing in what the drum is stripping off.

POWER TOOLS

↓ BEST FULL-SIZE WORK LIGHT

Metabo-HPT UB18DDQ4 \$239

This 10,000-lumen light is so powerful, you could mistake it for a tanning lamp. Not really, but its 6 x 7-inch LED array is incredibly bright. And the UB18DDQ4 is very user-friendly, running off of a battery or plugging in via a cable. The fold-out handle allows you to position it on the floor, and two threaded holes enable it to screw onto light stands.



↑ BEST BELT SANDER

Milwaukee M18 2832-20 \$279

Not only is this tool a great belt sander in its own right—owing to its speed, power, and compact size—it's an obvious tool addition to anyone already in Milwaukee's 18-volt system. We tried the machine on red oak, white pine, and lauan plywood. It performed flawlessly on each.



↓ BEST COMPACT CIRCULAR SAW

Ryobi PSBCS01 \$89

This circular saw delivers many of the same things contractors need—light weight, power, and safety—in a more accessible package. We ripped and crosscut Douglas fir framing lumber, for which the 24-tooth carbide blade is ideal. The 6½-inch saw has a cut depth of 2¼ inches—plenty for typical jobs.



↑ BEST PIN NAILER

DeWalt DCN623 \$299

Weighing just 4.6 pounds with a 2-Ah battery, this 20-volt, 23-gauge pin nailer appears small. But it's mighty. It fires fasteners (as short as ⅝-inch to as long as 1½-inch) just about as fast as you can pull the trigger, even into Douglas fir framing lumber.



↓ BEST DRILL DRIVER FOR
HOMEOWNERS

Denali ADL 5275B-11 \$100

This is a respectable little cordless drill. By “respectable” we mean that we chucked in a 7/16-inch twist drill and made full-depth holes in a pressure-treated 4 x 4. We then chucked in a 1/4-inch twist drill and made some holes in 1/4-inch steel. Yes, we noted some struggling, but the drill did everything we asked of it in our testing. We’ve seen similarly priced cordless drills stopped dead in their tracks by these tests.

↓ BEST IMPACT DRIVER
FOR HOMEOWNERS

Denali AID55 \$90

You can’t ask for much more from an impact driver. This one easily drove and removed No.10 x 3-inch construction screws into Douglas fir (without pilot holes). And at this price, you get the 3-pound tool, a charger, and two 2-Ah batteries. It’s hard to beat the value.

↓ BEST DRILL

Ridgid R86114KSB \$129

If you’re looking for a great balance of weight and power, this Ridgid is a good choice, weighing 3.8 pounds with a 2-Ah battery. It made 51 holes before running out of juice (a respectable number, given its small battery). And with 23 clutch positions, it affords you more control than other cordless drills in its class.





← BEST INSULATED-SCREWDRIVER SET

Klein 85076INS \$40

You may not need the electrical insulation on these screwdrivers; on the other hand, it can never hurt. It's an excellent, lightweight set of high-quality drivers regardless. The ribbed insulation handle affords outstanding grip, and the neatly machined tips fit with a satisfying socket action into screw heads.

← BEST PRECISION SCREWDRIVER

Klein 32328 \$20

You get a drawerful of precision tech screwdrivers in this one tool, with 26 well-machined bits stored in its handle. Among those are truly tiny sizes, such as 000 Phillips and ones sized specifically for Apple products. Place your index finger on the spin cap and turn the handle to loosen or tighten even tiny fasteners with ease and confidence. When you lift the bit free, the powerful magnet in the barrel lifts the fastener free, too.



↑ BEST PRECISION WRENCH

PipeVise Micro5 SW 127-14 \$62

Clasp the jaw of this self-adjusting wrench around a pipe (anywhere from approximately $\frac{5}{16}$ inch to $\frac{1}{2}$ inch in diameter), and you find it produces a surprisingly powerful bite. Moving it in the direction of the teeth loosens the grip; moving against the teeth tightens the grip. That tooth configuration and the spring-loaded jaw enables rapid-fire ratchet action to tighten or loosen.



↑ BEST HANDSAW

Disston D-8 \$250

Disston D-8 handsaws were last produced in the 1950s. We were thrilled when the company told us it was bringing back faithful reproductions of them, made in Sheffield, England, using the original blueprints. We tried a coarse-tooth rip version and a fine-tooth cross-cut on Douglas fir framing lumber. The saws cut as well as the old-timers say the originals did.

↓ BEST TORPEDO LEVEL

ToughBuilt

TB-H2-L-9X \$35

A level with an extension that slides out, extending the tool from 9 to 15 inches, isn't a gimmick. This ToughBuilt gets our vote (as does its big brother, the TB-H2-L-24X, which extends to 40 inches). It's machined out of sturdy aluminum, and its top bubble (the horizontal vial) settles very fast, making it quick and easy to find level without a lot of trial and error.

↓ BEST UTILITY KNIFE

Knipex 90-10-165

CutiX \$26

Over time, various snap-off utility knives have passed through our shop. We weren't impressed with any until we used this Knipex. It cuts smoothly and feeds out spare blades just as well. Its slide-out spine provides a place to put your thumb during tough cuts, and its magazine holds 16 spare blades. Our test cuts on carpet, flooring, and insulation were all nice and neat.



ACCESSORIES



↑ BEST COMPACT WORK LIGHT

Streamlight Sycamore Jr. \$66

Pretty much the only thing “junior” about this tiny light (it measures 2¼ inches square) is its name. We are amazed at its brightness and versatility. Its LED bulb has maximum output of 210 lumens (and 3.5 hours of run time). The light head turns 360 degrees on its base or hangs from a fold-out hook. Its magnetic base is so strong, it sticks like a barnacle to typical steel objects.

↑ BEST LASER LINE

Milwaukee 3624-20 \$549

Milwaukee’s 12-volt, four-point laser is about as fast to set up and as bright as such a tool can be. It gives you a crosshair laser line out its front, allowing you to place a wall’s location along the floor and on the adjacent wall (for example). It also marks plumb (out of its top) and level (out of its left and right side). Furthermore, its magnet base is so strong, you can practically do a chin-up off the thing.



← BEST SPADE BIT SET

Diablo DSPD4910-S3 \$20

We’re not normally big fans of spade bits that have a lead screw tip, since they tend to feed the bit faster than the bit can eject chips, which can lead to the bit binding up and stalling out in the hole. Not so with these from Diablo (in 5/8-, 3/4-, and 1 1/8-inch sizes). We chucked them in our biggest cordless drills and easily plowed through both sides of a pressure-treated 4 x 4.



↑ BEST HOLE-DRILLING GUIDE

Kreg KDG-6000 \$8

This little (4³/₄-inch-long) guide is handy to help you accurately drill holes in a board's face or edge. It has hardened steel sleeves in different diameters, and the guide is self-centering. Place it on the board's face and run the drill bit through it; the nonslip base holds the position while you drill. Place it on the board's edge, and the base's shape centers itself, allowing you to accurately place a hole.

↑ BEST CLAMP

Rockler 65890 \$23

Rockler's clamp operates like any bar clamp in that you pull it open by gripping its release lever with one hand and sliding the front jaw out with the other. But when you open it, you're operating its spring-load mechanism. Therefore, to close its jaws on what you want to clamp, just press the trigger, and the front jaw springs back against the surface. To tighten, squeeze the handle. Brilliant.



↑ BEST FULL-BRIM HARD HAT

WaveCel T2+ Pro \$169

The brains of a do-it-yourselfer, a construction volunteer, and a professional are all the same when it comes to injury. The same fall (or falling object) that injures one will injure the other. The WaveCel technology in this helmet offers far greater protection due to a honeycomb-like plastic liner that absorbs and distributes impacts better than traditional helmets. It's the same tech used in many bicycling and snow-sport helmets.



↑ BEST PANEL CARRIER

Kreg KMA 3000 \$24

We admit that we looked askance at this gadget. Maybe after decades of carrying sheets of plywood and other materials, we thought there wasn't a way to do it better. But this thing allows you to carry a panel in one hand while leaving the other free to open a door or move a sawhorse out of the way. It's ruggedly constructed, too, out of steel and plastic. **PM**



Colorful, Accurate Inkjet Printers for Your Documents and Photos

BETWEEN TODAY'S REMOTE-WORKPLACE DEMANDS and a looming tax season, you likely have a lot of paperwork on your hands. You need a reliable printer to quickly crank out hard copies of important documents. The inkjet printer is one of the most ubiquitous everyday devices found in any home. Beyond text reports, these excel in graphics for printing colorful photos and images. But with hundreds of models in-store and online, finding the right printer can be daunting. That's why we've compared the three best printers we tested in the past year. While their up-front cost might be pricey, they are a worthy investment for their versatile feature sets, superior colors, and high performance marks in our lab tests.

HOW WE TESTED

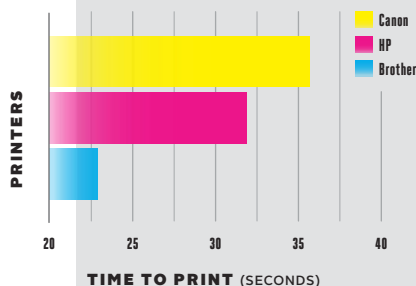
→ After connecting each printer to the same WiFi network and performing a print-head alignment, we began our testing. To evaluate each inkjet printer, we looked at three core areas: print speed, color accuracy, and sharpness. Our test prints included a 10-page black-and-white Word document, an image test key (made up of reference colors, a series of fine lines, and two photos), and the cover from a previous issue of *Popular Mechanics*. We used two 8.5x11-inch paper types: a 24-pound bright-white paper for the text document and a 61-pound matte paper for the images.

Measuring print speed was as simple as timing each printer while it processed a 10-page Word document from the time we hit send to the finished job. To assess the quality, we compared text blackness and fill levels around the character edges. We magnified the fine lines on the test key to evaluate each printer's sharpness, looking for jagged lines or edges with light ink filling. Lastly, we assessed color accuracy by using a colorimeter to measure and compare the color values (cyan, yellow, and magenta) from the same point on each printed page to the digital source file's properties.



PICKING UP SPEED

Those looking for blazing black-and-white print speeds should lean toward Brother's J5855DW workhorse. This model ripped through our 10-page text doc the fastest, as seen on the graph below. Jobs start almost as soon as you hit print, with minimal processing time compared to the extra 3- to 5-second delays on the other models. While the Canon's and HP's ppm (pages per minute) speeds aren't slow (17.5 and 19, respectively), especially in the grand scheme of printers from budget to premium, they're not in the same league as Brother's.



COMPARING COLORS ▶▶▶

As manufacturers aim to accommodate a variety of paper types, they need to tune their inks for the best performance across all media. Canon's Maxify offered the most accurate color reproduction of the pool image, with color values coming the closest to the actual properties of the digital file. For example, its cyan was the purest, at 81 percent of this level, with minimal 15 percent magenta and 9 percent yellow breaks. Blue hues in our pool photograph look more life-like and came through more clearly on the page—water ripples retained their highlights and shadows. On the other hand, HP's 9015e cyan reproduction was marred by higher levels of magenta (51 percent versus Canon's 15). While the blend of other colors lent the HP a contrast advantage for more pop, it drowned out details in the lighter areas, either minimizing or losing those subtleties entirely.



FOCUSING IN ON SHARPNESS

The Brother J5855DW provided the sharpest prints for those who need fine detail. From the edges of text characters in a 10-page document to the cleanest lines in images, this model packed the most precision into each job. Zooming in on our image test keys, we saw that the fuzzier edges of the HP test lines weren't as defined. And while Canon's Maxify produced studio-quality images, the corners and lines weren't as dark.

BEST OF THE TEST



BEST FOR PHOTOS

CANON MAXIFY GX5020

★★★★☆

Price: \$399 / **Print Speeds:** 17.5 ppm / **DPI:** Up to 600 x 1200 / **Weight:** 19.8 lbs / **Paper Capacity:** 350 sheets / **Media Size:** Up to 8.5 by 47 inches / **Office Functions:** Print only

Photo quality is significantly crisper on the Maxify, thanks to more lifelike colors and definition, which better reproduce subtle details like light reflections and shadows in the final product. Its 17.5 ppm speed won't blow you away, but it's plenty fast for everyday prints. This printer's built-in smarts automatically adjust images to best fit the media they're printed on, so no text or corners are cut off. However, it lacks a scanner bed and touchscreen controls, which can turn off those who require extensive office functionality.

BEST FOR OFFICE

HP OFFICEJET PRO 9015E

★★★★☆

Price: \$300 / **Print Speeds:** 19 ppm / **DPI:** Up to 1200 x 1200 / **Weight:** 20.4 lbs / **Paper Capacity:** 250 sheets / **Media Size:** Up to 8.5 by 14 inches / **Office Functions:** Copy, fax, print, scan

While the OfficeJet is a jack-of-all-trades, it's a master of none. There are plenty of useful features from self-healing WiFi to remote access, automating the tedious printing process down to the click of a button. Unfortunately, its ink cartridges aren't capable of printing color photographs as accurately as the other models. But it's still one of the best performers we tested and is the easiest to navigate.

BEST OVERALL

BROTHER J5855DW

★★★★☆

Price: \$300 / **Print Speeds:** 26 ppm / **DPI:** 600 x 600 / **Weight:** 39 lbs / **Paper Capacity:** 250 sheets / **Media Size:** Up to 11 by 17 inches / **Office Functions:** Copy, fax, print, scan

Brother's heavy-duty J5855DW is a well-rounded printer with fast speeds, accurate colors, and sharp definition. Like the Canon Maxify, it uses a large ink reservoir for more economical ink costs over time. While the Canon's colors are slightly more accurate and extract more detail from an image, the Brother is more affordable, includes a touchscreen, and offers a scanner bed. This is our top pick for the best everyday printer. **PM**

Read about all the printers we tested at [popularmechanics.com](https://www.popularmechanics.com).



PRODUCT

Felco 2 Pruners

PRODUCT: Felco 2 | ACQUIRED: 1997 | FUNCTION: Bypass Pruner

▶ **ONE DAY SEVERAL** decades ago, I was delivering freshly sawed plant stakes to nurseries in Pennsylvania near where I lived. I noticed one thing about the workers there: Almost everyone sported what looked like the same Felco pruner in a worn leather holster on their hip. Seeing so many pros devoted to a product left an impression. So, years later when I went to buy a pruner for my own purposes, I bought the Felco 2 (sometimes called the F-2). And it's served me extremely well.

If there's one thing I appreciate even more than its durability, it's the tool's high-carbon steel blade, which takes an incredibly sharp edge. A sharp pruner yields a clean-cut surface that speeds plant healing. I like everything about my old Felco, from its well-shaped handles to the rubber stops that cushion its closing action. And Felco offers something like 20 replacement parts for the 2, right down to rivets and bushings. After all, if it's broke, fix it, but don't change it.—*Roy Berendsohn*



Karen James is a noted journalist and expert in sex and relationships.

ADVERTISEMENT

Ask The Expert

Love, Marriage, and
Sex After 50!

The Amazing Sex Secret Of A 78 Year-Old 'Italian Stallion!'

A Secret Any Man Can Use...

This month I got a letter from a reader in Texas about a "little secret" that has renewed her sex life with her husband!

Tina writes: Dear Karen,

For years my husband and I had a wonderful love life, but when he reached his 50s, he lost some of his old spark, especially in the bedroom. He tried every product available, but nothing worked. For the past few years, it's felt like we were roommates, not husband and wife.

Well, last month he came home from a business trip in Europe and shocked me with more energy and passion than he's had in years. He took me in the bedroom like we were newlyweds and gave me a night I'll never forget. It was just incredible, and our love life has been like that ever since. So here we are, closer than ever and enjoying the best sex of our lives... in our 50's!

On his trip, my husband stayed in a hotel room next to an Italian nutritionist and his wife and heard them passionately making love every night. He figured they must be in their twenties, but one morning he encountered them in the hallway and it turns out, they were in their 70s!

Instead of being embarrassed that they'd been found out, they were positively glowing and happy to share their "secret." The man pulled out a small pack from his satchel, gave it to my husband and said "These tablets come from a small town up north and are made from naturally pure extracts, packed with densely rich sexual nutrients. They will give you powerful erections and you will perform in the bedroom even better than you did as a young man. Then he laughed and said, "You will become an Italian Stallion, like me!"



"My husband shocked me with more passion than he's had in years. He took me in the bedroom like we were newlyweds and gave me a night I'll never forget!"

Karen, my husband has been taking one tablet each morning with breakfast, but the pack is almost empty and we both desperately want more. Do you know about these European tablets and how to get some in the States?

Sincerely,

Tina D., Fort Worth, TX

Tina, you're in luck, I do know about them. Ever wonder why older men from Italy and all over Europe are famous for staying energized, passionate, and sexually active well into their golden years? For decades, these men have relied on a unique blossom seed extract to enhance their bedroom power and performance.

Milled on the fertile northern plains, and sold under the brand name Provarin, these pure plant extracts have a legendary reputation throughout Europe for naturally fueling extremely hard erections. As Giovanni from Milan put it, "It's like bedroom rocket fuel - especially for us older guys!"

All-natural and safe to take, Provarin is a well-kept secret for those in the know. An old-school, family business, they still harvest product by hand and don't do any advertising. Long-time customers and word of mouth ensures their limited stock is sold out every year.

They do have a distributor here in the U.S. and Provarin is surprisingly inexpensive. A spokesman told me they were proud to produce the highest quality product for men and couples. He went on to say that if any of my readers call and mention this article, they'll get a special one time double-discount, plus free shipping and a bonus pack of 30 tablets free!

Wow, so there you go, Tina - and the rest of you readers! The offer is only good while supplies last so give them a call today. The number is **1-800-585-8503.**

Aren't you glad you asked?

Karen

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KTM Used Fuel Injection to Revamp Two-Stroke Engines

TWO-STROKE ENGINES USED TO BE UBIQUITOUS IN DIRT bike racing, thanks to their lightweight construction and horsepower. Packed in a dirt bike frame, they make a motorcycle playful in the corners and plenty fast when the throttle's wide open. Manufacturers kept plugging away at roughly the same recipe for decades until Yamaha released its YZ400F four-stroke dirt bike, which won its first race (1997 Las Vegas Supercross) with relative ease. This achievement marked the beginning of the end for widespread use of two-stroke engines in professional racing.

Following Yamaha's maiden success, other manufacturers were forced to follow suit, developing four-strokes of their own. The all-new motocrosser was the Japanese brand's response to California's increasingly stringent environmental regulations—which two-strokes could never comply with. However, these futuristic bikes brought many more advantages than just running cleaner. Four-

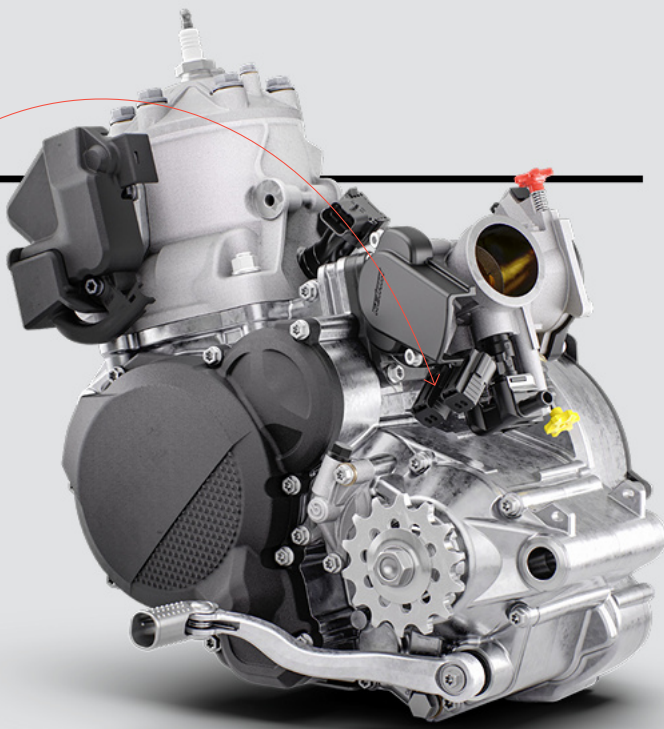
strokes provided more usable power and torque (especially lower in the rev range), making them much easier and more forgiving to ride. As brands scrambled to develop this newfound technology, two-stroke development went mostly dormant. Thankfully the big-foreheads on the KTM engineering team wanted to give these old-school motors a shot in the arm with fuel-injection.

Its new range of fuel-injected two-strokes aims to give the engines a new lease on life, making the bikes easier to ride, easier to wrench on, and easier on the environment. Traditional two-stroke motors are much more polluting than four-strokes because of the inefficiency of the carburetor along with burning oil within the cylinder head. Two-strokes have to run on a mixture of oil and gas to keep the engine properly lubricated. Thankfully, fuel injection solves most of this inefficiency, making the new bikes run cleaner than their carbureted counterparts, lowering fuel consumption while simultaneously widening the traditionally microscopic powerband.

That said, these Austrian two-stroke machines aren't fuel-injected in the same way as your car. Under the hood, most modern engines feature direct injection, where fuel is squirted directly into the combustion chamber. KTM very nearly released direct-injection bikes in 2015, but ultimately found the technology too complicated to apply to dirt bikes. "The thermal stress on components like the piston and conrod along with the difficult air-fuel mixture preparation are a no-go for a motocross bike," says Florian Bretterebner, head of off-road engine development at KTM. "A direct-injected bike would be heavier, less performant, and a lot more expensive than the system we chose."

The system they initially went with was Transfer-Port Injection (TPI), a much better alternative for the brand's 2018 lineup of enduro bikes—steadily perfecting the technology up to the recent 2023 model-year bikes. TPI bikes use fuel injectors within the transfer port located between the crankcase and the cylinder. However, the newest Throttle-Body Injection (TBI) bikes use an evolution of roughly the same concept, with fuel injectors within the throttle body instead of the transfer port. KTM says this new design allows for a much more homogenous air-fuel mixture, which leads to improved combustion.

Note the twin fuel injectors mounted at the throttle body instead of the transfer port—allowing for improved combustion.



Carburetors vs. Fuel-Injection



CARBURETORS USE THE VACUUM CREATED

by the intake stroke of the engine to force air through their ports and passages. As the air flows through, it simultaneously forces fuel into the combustion chamber. Fuel is then fed

through tiny passages called "jets," which control how much gas flows into the combustion chamber—most carbs feature two jets, with the main jet controlling the fuel mixture at mid to high RPMs and the pilot jet controlling from idle to the middle of the rev range. While carburetors are elementary in function, tuning them properly is a long and arduous job that only veteran mechanics have perfected.

"Once you have a two-stroke 95 percent of the way there, that last 5 percent is really what's difficult to get down," says Joe Adragna, an amateur motocross racer who rode two-strokes throughout his childhood.

While a carburetor allows you to adjust the air-fuel ratio, it's more of a set-it-and-forget-it type of device. Fuel injection (or throttle-body injection in the case of KTM's two-strokes) is continuously variable. The process is now controlled automatically via an onboard engine management system that ensures a near-perfect air-fuel ratio all of the time. With more usable power and higher fuel efficiency, these engines feel much closer to a four-stroke when twisting the throttle open.

"We saw the benefits on the four-stroke side when we made the switch from carb to EFI more than 14 years ago," says Bretterebner. "Some of these benefits apply even more on a two-stroke engine, which is more sensitive in terms of air-fuel ratio."

With fuel-injected two-strokes running almost flawlessly



KTM moved the engine closer to the bike's center of gravity to improve cornering.

out of the box, riders can spend more time riding and less time tinkering with the carburetor. While solving needless bike work is great for weekend tinkers, it's paramount for professional racers like Taylor Robert, who don't always have immediate access to a mechanic to keep their bike in tip-top shape.

"Not having to worry about that as a professional racer takes a whole different element out of it," says Robert, who has competed on every generation of KTM's fuel-injected two-stroke dirt bikes since 2018. "I can just go out and ride without having to sit and tinker with my bike."

Fuel-injected two-strokes also pay big dividends for hard enduro riders like Robert in races such as Red Bull's Sea to Sky event, which starts on the beach at sea level and ends on a mountain at nearly 9,000 feet. "The cool thing about fuel injection is that the bike runs well the whole time no matter where you are on the course," says Robert; just like us humans, an engine at elevation needs much more air to continue running properly. While this would require a complete re-tune, KTM's fuel-injected two-strokes have an engine management system that can continuously maintain a nearly perfect air-fuel ratio. "I've done that race on a carbureted bike, which was barely running by the time I got to the top," says Robert.

Along with running properly at different elevations, Robert also mentioned that these fuel-injected two-strokes deliver on their promise of making the bike ride like a four-stroke. "The early TPI bikes had a flatter power curve, but didn't have a ton of top end," says Robert. "For

hard enduro, you want the power to hit low in the RPMs where you have good traction and you're not spinning your wheels." The TPI power curve was fine for hard enduro riding, which requires quick hits of throttle (and clutch control) to successfully navigate the obstacles on course. However, this condition could prove problematic for motocross, which involves much higher speeds—and therefore more time spent at wide-open throttle.

That's where the throttle-body-injection (TBI) bikes come into their own, keeping the linear power delivery of TPI while eliminating the previously anemic top-end performance. "You now have that raw power when you get to a fast straightaway or a race start, for example," says Robert. Sure, KTM can't promise a holeshot every time you dump the clutch on a TBI bike, but you'll have access to more power at wide-open throttle—which will help you get there. "I don't want to say these bikes have made the sport easier, but they've helped elevate the sport," says Robert.

It's unclear whether this technology will trigger a two-stroke revival, but KTM remains committed to teaching these old dogs new tricks. And that's not entirely surprising, as quite a few casual riders and even professional racers still prefer the old-school feel and sound of these engines. This is especially evident in enduro racing, where KTM's own Manuel Lettenbichler won the 2022 FIM Hard Enduro World Championship on a fuel-injected two-stroke. At the end of the day, the Austrian manufacturer says it will keep developing these bikes as long as there is sufficient demand from buyers. **PH**

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▲
**Mold Armor
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A friend, whose house exterior was remarkably clean, put me onto Mold Armor several years ago. It's become my go-to product for removing mold and mildew, and the surface stays cleaner a lot longer. The primary ingredients are bleach, surfactants (surface-active agents that reduce water tension), and cleaner. But it also contains Microban, proprietary antimicrobial chemicals that kill bacteria and fungi, leaving residue that makes the surface less hospitable for their return. To use it, hook your gar-

den hose to the connector on the bottle and apply the Mold Armor. Let it sit 10 minutes, then rinse it off. For really dirty areas, use a garden sprayer to apply it full-strength, then rinse. If the surface is truly awful, apply it with the garden sprayer, scrub with a siding brush on a pole, reapply Mold Armor full-strength, let sit for 10 minutes, then rinse with water. On a recent volunteer job, we took the outside of a house and outdoor furnishings from black and slimy to attractively clean and fresh. Results like that keep me coming back for Mold Armor refills every spring.—Roy Berendsohn

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POPMECH PRO

It's easy to lose track of all the perks that come with your PopMech Pro membership, like exclusive features, detailed plans for DIY projects, and a weekly members-only newsletter. **Here are some of the best recent Pro stories you might have missed.** (Not a member? Head to popularmechnics.com/join.)

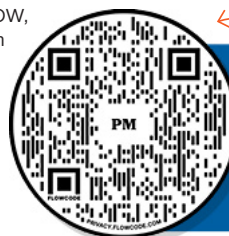
HOW TO REMOVE A STRIPPED SCREW

Few things will try your patience the way a stripped screw or bolt can. It seems the closer you get to completing a project, the more likely you will be to run into one—something that Test Editor Roy Berendsohn knows all too well. In a popular member-exclusive video, Berendsohn demonstrates some foolproof ways to pull out those pesky fasteners. Steal his tips and tricks at popularmechnics.com/stripped-screw.



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There's a brand-new, exclusive **digital issue of PopMech** available NOW, and it's packed with original, in-depth feature stories you can't find anywhere else. (Think: the Navy's new \$13 billion aircraft carrier and the mind-blowing mystery behind death.) **To immediately unlock the issue, head over to popularmechnics.com/digital-issues.**



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SOLVE IT: THE SEVEN HOUSES RIDDLE

This feline head-scratcher stumped members in one of our Sunday newsletters. You can find the answer at popularmechnics.com/seven-houses.

A vast estate contains seven houses. Each house contains seven cats. Every cat lords over seven mice. Each mouse runs through a forest of seven stalks of spelt. Each plant grows seven lone grains. In all, how many items and creatures can you count in the houses?

FIELD TEST ►

Hundreds of PopMech Pro members have signed up to field-test products for *Popular Mechanics*. This issue, we sent testers a **DeWalt Xtreme 12V Max Impact driver** to put it through its paces. With a fair price [\$159] and lightning-quick charge time, this cordless kit shined. Here's what Kate A., of New Milford, CT, had to say:

"Sometimes my hands get fatigued during big projects because the tool is too big or too heavy. But the driver was very comfortable in my smaller hands, and the trigger had very little resistance."



BECOME A PRODUCT TESTER! → Join PopMech Pro for the chance to try cool new tools and see your feedback appear here. We're looking for testers from all backgrounds and skill levels. **Apply now at popularmechnics.com/become-a-field-tester.**



PHOTOGRAPH BY THOMAS HENGGE



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